# Pit and Quarry

SAND ▪ GRAVEL ▪ STONE

HANDLING ▪ CRUSHING ▪ SCREENING ▪ WASHING

## A Captain of Industry Once Said--

*"I don't attempt to remember all the information that might be useful but I make it a point to know where to get it."*

TO be able to get information quickly, without difficulty may often save you considerable money.

Pit and Quarry HAND BOOK is a real contribution to the field for it contains a wealth of information on all phases of the Non-Metallic Mineral Industries — information that would otherwise be unobtainable without considerable time and labor to you.

Use the HAND BOOK when you want data on methods, production or equipment.

RECEIVED
JUN 12 1925
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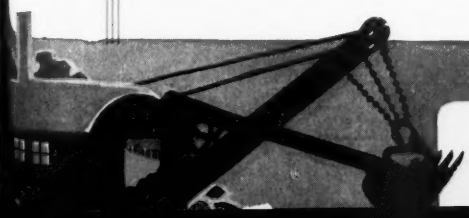
ANN ARBOR, MICH.

Pit and Quarry
HAND BOOK

RAND-McNALLY BLDG., CHICAGO


June 1, 1925



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An Outstanding Achievement
at an Astonishingly Low Price

Write for Book 120!

INDUSTRIAL
CRAWLING TRACTOR CRANES

INDUSTRIAL WORKS · · · BAY CITY · MICHIGAN

Two of the three ERIES owned by Ohio Valley Rock Asphalt Co., Summit, Ky. Mr. Dover Williams, Vice Pres., writes: "In view of the highly satisfactory service our ERIES have given, we now use nothing but ERIES."

## You've seen how ERIE owners keep on coming back for more

Anyone who gets around and talks to stone producers — and sees their quarries— knows about the *fleets* of ERIES that are owned by the most successful concerns.

There are many of these fleets of ERIES in quarries all over the country— fleets numbering from two or three ERIES up to seven or eight. Owned by well known stone producers like these listed at the left.

And concerns like these don't keep "repeating"— even on an ERIE Shovel— without being sure that it's the best buy.

The quarryman who has had ERIE Shovels is used to the ERIE'S quick, snappy action that means *output*, and its sturdy strength that keeps it working *all day, every day.* He is hard to satisfy with less.

It pays to be as careful a buyer as the companies listed here.

**Just a few** of the many well-known quarries who have found the ERIE the best shovel "buy" — and keep coming back for more:

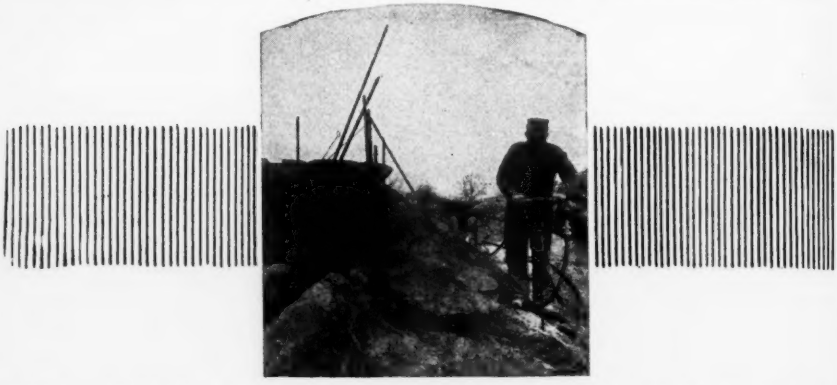
American Lime & Stone Co., Tyrone, Pa.
J. E. Baker Co., York, Pa.
Boggs & Burnam, Richmond, Ky.
Chemical Lime Co., Bellefonte, Pa.
Cherokee Rock Asphalt Co., Louisville, Ky.
Commonwealth Quarry Co., Summit, N. J.
Connecticut Quarries Co., New Haven, Conn.
Consolidated Sand & Stone Co., Upper Montclair, N. J.
Cushing Stone Co., Schenectady, N. Y.
Hagersville Quarries, St. Thomas, Ont.
Interstate Crushed Stone Co., Springfield, N. J.
Kennedy Refractories Co., Tiffin, O.
Ky. Rock Asphalt Co., Louisville, Ky.
Sowerbutt Quarries, Paterson, N. J.
York Hill Trap Rock Co., Meriden, Conn.

**ERIE STEAM SHOVEL CO.,**
**Erie, Pa., U. S. A.**

Builders of ERIE Shovels, Cranes, Ditchers, Draglines, Trench Hoes, etc.

**Branch Offices: Boston, New York, Philadelphia, Pittsburgh, Atlanta, Chicago**
**Representatives throughout the U. S. A.**

**ERIE Revolving Shovels**



# YOU CAN GET MORE WORK INTO A DAY BY USING CLEVELAND DRILLS

MOST rock drill operators know about the Cleveland Famous Forty Four. For years this sturdy rock-eater has been making money for quarry men and contractors all over the country. Only a few days ago the operator of one of the largest sand-stone quarries in Northern Ohio said to the Cleveland salesman,—"Your drills are saving us $25,000 this year!"

***Ask us for Bulletin No. 49***

## The Cleveland Rock Drill Co.

**3734 East 78th Street** **CLEVELAND, OHIO**

CHICAGO, ILL. 05 S. Dearborn St.
NEW YORK CITY 30 Church St.
NEGAUNEE, MICH. 222 Heath St.
DETROIT, MICH. 428 Insurance Exchange Bldg.
ST. LOUIS, MO. 2091 Railway Exchange Bldg.
PHILADELPHIA, PA. The Bourse Bldg.
BIRMINGHAM, ALA. 403 N. 24th St. Box 2028
BOSTON, MASS 113 Pearl St.
PITTSBURGH, PA 922 Farmers Bank Bldg.

**Canadian Trade Supplied by The Cleveland Pneumatic Tool Co. of Canada, Ltd., Toronto, Ontario**
**British Representatives, John McDonald & Co., Pollokshaws, Glasgow, Scotland.**

THE NO. 44 FOR AIR

NO. A-1 FOR STEAM

# CLEVELAND

# KOEHRING

## Crane Excavator

## 66% Greater Clutch Frictional Area!

THAT'S why the Koehring has *Finger-tip control* at the levers!

*Levers* work easy because the 66% greater contact surfaces of the double outside band, equalizing friction *clutch* makes the levers work easy!

So, you have Finger-tip control without mechanical complications to help shift levers which ought not to be hard shifting in the first place. The Koehring operator does not lose the *"feel"* of the bucket —an important factor in accuracy of operation!

### Crane Capacities

**No. 1**—10 tons at 12 ft. radius. Clamshell buckets loaded with sand or gravel: 1 cu. yd. bucket weighing 3450 lbs. at 28 ft. radius, ¾ cu. yd. bucket weighing 2600 lbs. at 34 ft. radius. Boom lengths to suit conditions. 4 cylinder, 5" x 6" gasoline engine, 1000 R.P.M.

**No. 2**—15 tons at 12 ft. radius. Clamshell buckets loaded with sand or gravel: 1¼ cu. yd. bucket weighing 3850 lbs. at 32 ft. radius. 1 cu. yd. bucket weighing 3450 lbs. at 36 ft. radius. ¾ cu. yd. bucket weighing 2600 lbs. at 43 ft. radius. Boom lengths to suit conditions. 4 cylinder, 5¾" x 7" engine, 1000 R.P.M.

KOEHRING HEAVY DUTY

*Write for Crane Excavator Bulletin No. Cr.32.*

KOEHRING COMPANY

PAVERS, MIXERS—GASOLINE CRANES, DRAGLINES AND SHOVELS

MILWAUKEE, WISCONSIN

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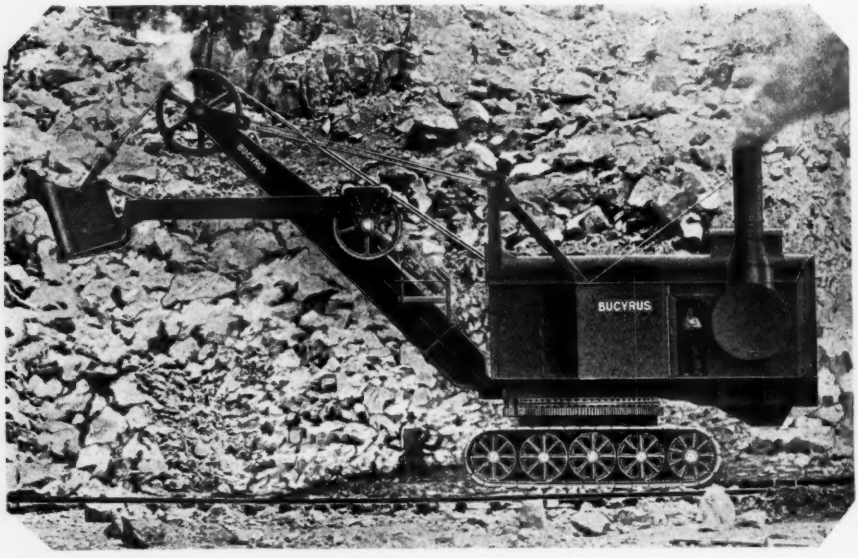
***Foreign Dept.***, Room 1370, 50 Church St., N. Y.
***Canada***, Koehring Company of Canada, Ltd., 105 Front St., East, Toronto, Ontario.
***Mexico***, F. S. Lapum, Cinco de Mayo 21, Mexico, D. F.

A2688




# Bucyrus Engineers Have Perfected A New 4-Yard Revolving Shovel

## *With Greater Ruggedness, Speed and Mobility*

THIS new shovel—the 120-B—is a revolutionary development in heavy duty excavating machinery. In it, Bucyrus engineers have combined the advantages of the powerful railroad type shovel with those inherent to a revolving shovel.

Quick-acting, heavy digging, close-coupled and caterpillar mounted—it is built specially for quarry, mining and heavy rock excavation work.

Where more steel means lower maintenance and less repairs, more steel has been used. Revolving frame and base are solid steel castings. Shafts are built with 30 to 50% more strength than heretofore used in conservative design. Boom with the same section as a stripping shovel of twice its size.

Boiler has 10% more grate area and 15% greater heating suface than the most powerful railroad-type shovel. Superheater and fire-brick arch, as standard equipment, reduce fuel consumption from 20 to 30%. Electric shovel with latest Ward Leonard control and shunt motors.

Bulletin D-1201-A will give you the complete specifications—Copy gladly furnished on request.

# BUCYRUS

*Established in 1880*

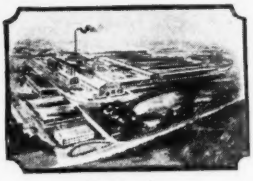
Railroad Type and Revolving Shovels of All Sizes, Dragline Excavators, Trench Excavators, Dipper, Hydraulic and Placer Dredges, Spreader Plows, Wrecking Cranes

**BUCYRUS COMPANY, SOUTH MILWAUKEE, WIS.**

New York Chicago Birmingham San Francisco Portland Denver Tokyo London

*A Special Plant at Evansville, Indiana, Devoted Exclusively to Small Revolving Shovels*

**High Bridge, N. J.**
Manganese Steel
Wearing Parts



**Easton, Pa.**
Special Trackwork
Cylinders for Gases
Hollow Rollers

**Philadelphia, Pa.**
Rolls and Rolling
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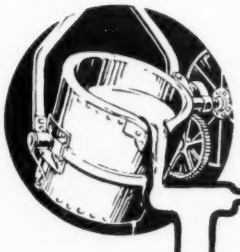
Forgings



In Pit and Quarry operations, where the work is admittedly hard on wearing parts, the use of TISCO manganese steel chain and sprockets will pay a regular dividend for they will give maximum service.

The life of ordinary chain handling abrasive materials is usually brief. With the advent of TISCO manganese steel endurance has been materially prolonged. TISCO chain and sprockets will last from 5 to 15 times longer than malleable chain.

**Taylor-Wharton Iron & Steel Co.**
**High Bridge, New Jersey**

TISCO

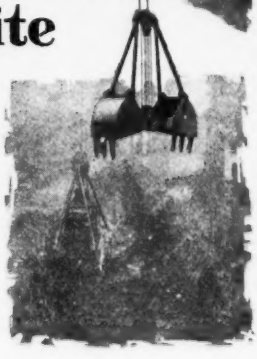
Guarantee
Owen Buckets, properly installed and operated, are guaranteed to do a bigger day's work than any other bucket of the same weight and capacity—
—or—
Write your own guarantee!
THE OWEN BUCKET CO.

# A Mouthful at Every Bite

The crushing strength and the quick, sure snap of the crocodile's jaws insure his mouthful at every bite. And like the Owen Bucket, the ruthless swamp monarch tolerates no hinderance in his savage attack.

An Owen Bucket possesses the unusual capacity for "digging in" and taking a chuck-full bite every time. (1) A patented "cushion stop" permits the cutting edges to hit the material first without racking the bucket to pieces. (2) Instead of scraping over the material when the closing line is overhauled, the centrally located and low slung weight holds the bucket to the ground and makes the jaws dig for a capacity load.

These are but two of the nine points in superior construction that mark the Owen as a Bucket which means a greater value for your digging dollars.



This ¾ yard type "J" digging bucket is one of four owned by D. Lowensohn, Cleveland. It is shown here doing the "digging in" job of excavating pipe line trenches.

*We want you to know more about the Owen Bucket. Folder 2-A will tell you in detail about its strong and sturdy construction, its adaptability, its earning power.*—Send for it.

THE OWEN BUCKET COMPANY
606 ROCKEFELLER BUILDING -:- CLEVELAND, OHIO

New York, Pittsburgh, Philadelphia, Baltimore, Chicago, St. Louis, Miami, Los Angeles, Dallas, Portland, Minneapolis, San Francisco.

OWEN CLAMSHELL BUCKETS INSURE A BIGGER DAY'S WORK

# Owen Buckets

INSURE A BIGGER DAY'S WORK

©O.B.Co

# Why risk blasting success?

YOU have too much at stake in your investment for labor and explosives to risk the failure of complete detonation. The only way to be sure is to use du Pont Accessories—**always.** Du Pont Blasting Accessories are absolutely dependable. They have been developed by explosives experts having had extensive and practical experience in the detonation of explosives. Every stage of their production receives the most rigid inspection thereby insuring dependability and efficiency of performance. When ordering your du Pont Explosives, include du Pont Blasting Accessories such as:—

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| **Blasting Caps** | **Electric Blasting Caps** |
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| **Galvanometers** | **Rheostats** |
| **Leading Wire** | **Cap Crimpers** |
| | **Tamping Bags** |

It pays to use du Pont Blasting Accessories. They're **sure** fire **every** time.

Write for Blasting Accessories Catalog containing descriptions and illustrations of du Pont Accessories and practical information about their use.

*Du Pont chemical engineers insure uniformity of quality by chemical control through every step of manufacture from raw material to finished product.*

**E. I. DU PONT DE NEMOURS & CO., Inc.**
***Explosives Department***
**WILMINGTON, DELAWARE**

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*Du Pont Products Exhibit, Atlantic City, N. J.*

DU PONT

POWDER MAKERS SINCE 1802

*Marion Model 92 Electric Railroad Type Shovel*

*Owned by The Oklahoma Portland Cement Co.*

**The economy of Marion Electrics begins with definite voltage control. Shunt motors, with which you can "plug" or reverse under load, provide the maximum in flexibility and power with a minimum of current cost—a condition as near 100% perfect as is humanly possible in this day.**

***The ability to plug or reverse under load gives intense satisfaction to both operator and owner. The use of shunt motors eliminates complicated electrical apparatus and speeds up shovel operation.***

**The Marion Steam Shovel Co., Marion, Ohio, U. S. A.**

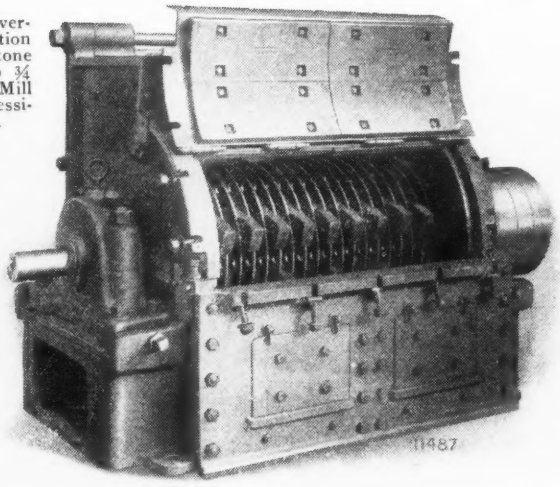
*Established 1884*

2814

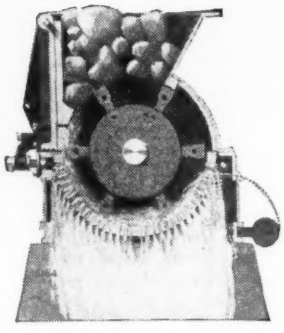
# MARION

# *For Cement and Quarry Service*

This Jeffrey Pulverizer in one operation reduces Limestone from 10 inches to ¾ inch for Ball Mill Feed. Note accessibility of machine.




## Jeffrey Swing Hammer Pulverizers



Sectional View of Jeffrey Pulverizer showing action of hammers.

FOR reducing such materials as Limestone, Shale, Slate, Clay, Chalk, Marl, Gypsum, Phosphate Rock, Asbestos, Cement Rock, Talc, Soapstone, Lime and other friable and fibrous materials. Built in types and sizes to suit varying requirements.

Auxiliary Jeffrey Standard Conveyors, Elevators and Drive Chains can also be readily arranged to form complete grinding and handling units.

Write Jeffrey Engineering Specialists fully concerning your reduction and handling problems and let them submit recommendations on the right equipment to meet the conditions.

**The Jeffrey Mfg. Co.** 917-919 North Fourth Street **Columbus, Ohio.**

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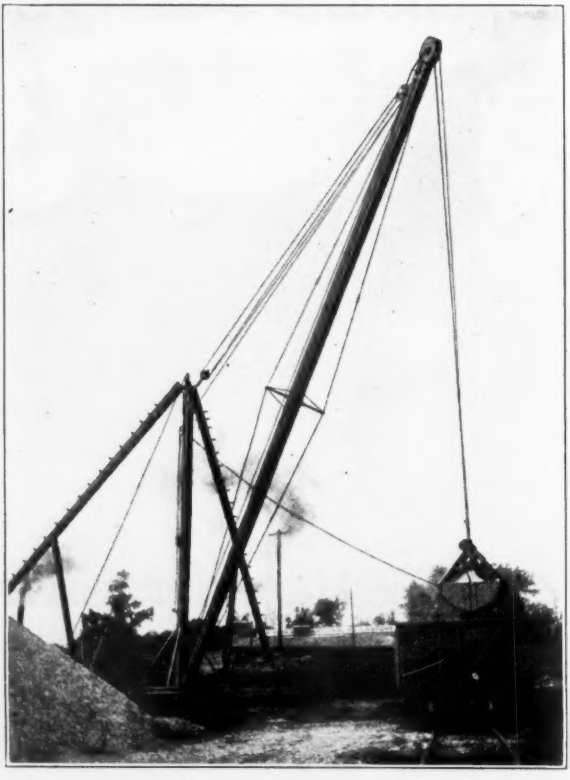
# JEFFREY
## MATERIAL HANDLING EQUIPMENT



## *"AMERICAN" Derrick Helps to Keep Three Paving Contracts Going*

At St. Paul, Minn., Thornton Bros. have three good sized street paving contracts. To insure fast and economical handling of aggregate they installed a central storage and mixing plant on a spur of the C. M. & St. P. tracks. All aggregate is unloaded by "AMERICAN" Stiffleg Derricks and Hoists. An average of 20 cars of sand and crushed rock is unloaded at this plant every day. Efficient handling of aggregates is a large part of the secret of success in large paving contracts. That is why so many aggregate producers and successful paving contractors use "AMERICAN" Hoisting Machinery.

**AMERICAN**
**HOIST & DERRICK CO.**
**Saint Paul, Minn.**
**New York, Chicago, Pittsburgh, Seattle, New Orleans**

# *The O-S Type "T" ¾Yd. Gas Shovel*

Sound principles of construction and unrivaled records of dependability that have made O-S Cranes famous, are to be found in the ORTON & STEINBRENNER Power Shovels.

Glance at the illustration above. Note the ruggedness of that gasoline shovel; the correct design; the powerful appearance; the wide Flexible Tread.

The Crowding mechanism of the O-S gasoline shovel is connected directly to the main motor by the use of a shaft and gear drive. No chains or ropes are used. The crowding device is controlled by the operator through friction clutches—absolutely the last word in shovel construction.

The Power Shovel is fairly a new member of the O-S line of dependable equipment. Our twenty-five years of crane building experience has taught us what a power shovel should be, and we have made it so.

O-S

*Locomotive Cranes*
*Flexible Tread Cranes*
*Clamshell Buckets*
*Orange Peel Buckets*
*Truck Cranes*
*Gantry Cranes*
*Power Shovels*
*Coal Crushers*

**Catalogs and Specifications Will Be Forwarded On Request**

## ORTON & STEINBRENNER CO.

608 So. Dearborn Street

CHICAGO, ILL.

# 50 Tons in 30 Minutes

THIS No. 2 crane with a ¾-yard Excavator bucket unloaded 50 tons of crushed stone from car to bin in 30 minutes. The Union Paving Co., Pine Grove, Pa. reports average of ten 50-ton cars of crushed stone handled daily.

This outfit—No. 2 crane and Excavator bucket—is hard to beat for tough digging or fast rehandling. May we send you complete details?

**Locomotive Cranes • Pile Drivers • Car Dumpers • Clam-shell Buckets • Derrick Cars**

C-2-81

NEW YORK BUFFALO PHILADELPHIA PITTSBURGH **CLEVELAND** DETROIT CHICAGO SAN FRANCISCO LOS ANGELES

# Modern Massillon Steam Shovel

## Giant Digging Power—

POWER
STRENGTH
SPEED
MOBILITY
LOW MAINTENANCE
ACCESSIBILITY
ENGINEERING ECONOMY
INTERCHANGEABLE REPAIRS

combined with Speed and Mobility gives you the sort of machine that aggregates the biggest production with the lowest maintenance cost and least loss of time. Contributing further to the Massillon's economy are its Interchangeable Repairs, Accessibility, Endurance and Dependability.

The Modern Massillon can be used with clamshell or dragline equipment, or as a locomotive crane. Send for our descriptive book.

Built By

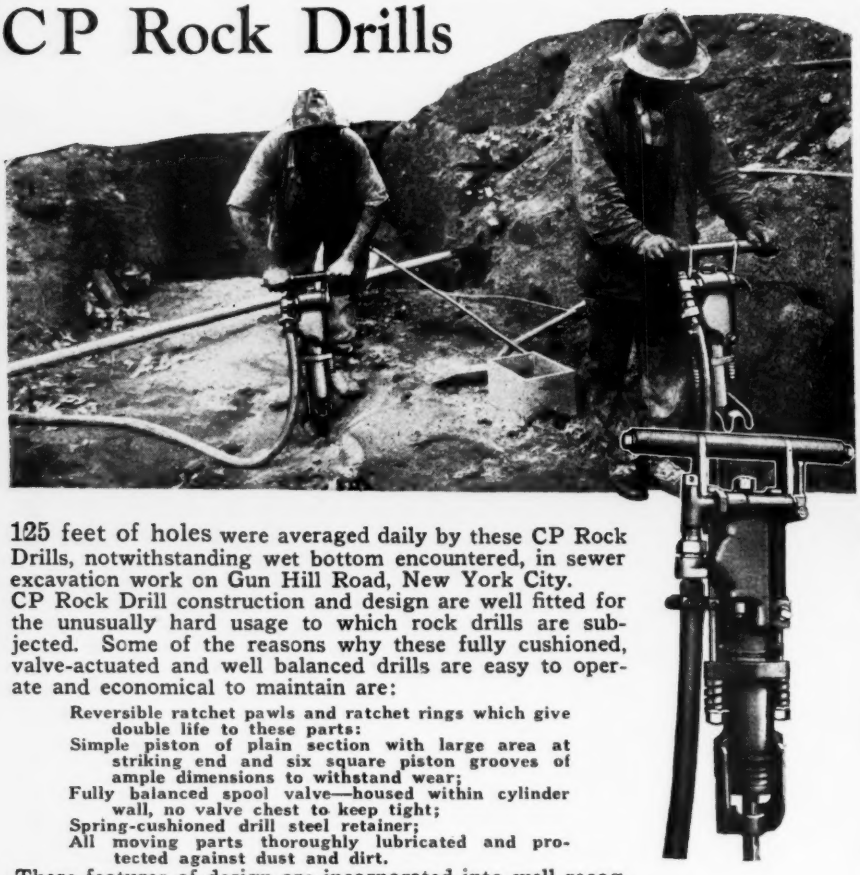
## THE RUSSELL & CO.

MASSILLON, O.

The MODERN MASSILLON

Steam — 3/4 – 7/8 RANGE — Shovel

# CP Rock Drills



**125 feet of holes** were averaged daily by these CP Rock Drills, notwithstanding wet bottom encountered, in sewer excavation work on Gun Hill Road, New York City.

CP Rock Drill construction and design are well fitted for the unusually hard usage to which rock drills are subjected. Some of the reasons why these fully cushioned, valve-actuated and well balanced drills are easy to operate and economical to maintain are:

**Reversible ratchet pawls and ratchet rings which give double life to these parts:**
**Simple piston of plain section with large area at striking end and six square piston grooves of ample dimensions to withstand wear;**
**Fully balanced spool valve—housed within cylinder wall, no valve chest to keep tight;**
**Spring-cushioned drill steel retainer;**
**All moving parts thoroughly lubricated and protected against dust and dirt.**

These features of design are incorporated into well recognized lines of construction that have stood the test of years.

If you are using CP Rock Drills, you *know* but if you are not yet CP equipped—write today for complete information.

R 72

## Chicago Pneumatic Tool Company

**6 East 44th Street, NEW YORK, N. Y.**
*Sales and *Service Branches all over the World*

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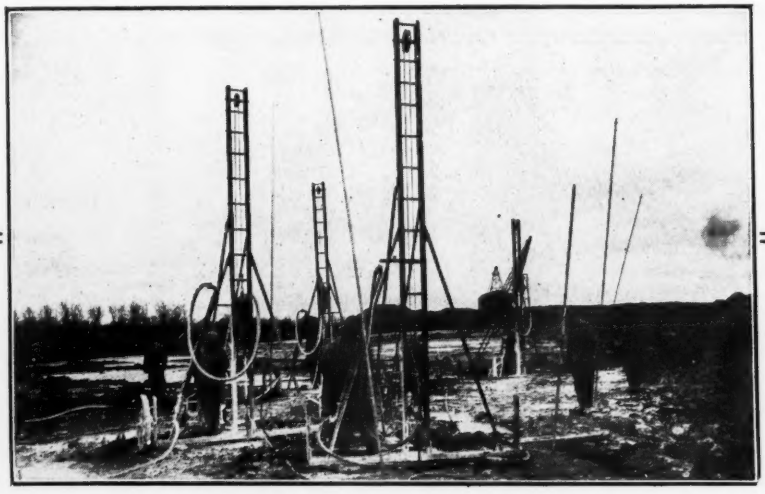
| Denver | *Philadelphia | *Berlin | Helsingfors | Moncton | Santiago | *Winnipeg |
| *Detroit | *Pittsburgh | *Bombay | Honolulu | *Montevideo | *Sao Paulo | |

Canadian Pneumatic Tool Company, Ltd., Montreal, manufacturers of Chicago Pneumatic products in Canada
Consolidated Pneumatic Tool Company, Ltd., London, manufacturers of Chicago Pneumatic products in England

BOYER PNEUMATIC HAMMERS··LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS··VACUUM PUMPS··PNEUMATIC HOISTS
GIANT OIL AND GAS ENGINES ROCK DRILLS ·· COAL DRILLS

**CHICAGO** *Rock* **PNEUMATIC** *Drills*



Four Model 21 Turbros on Derrick Rigs

## Drilling Primary Holes with Waugh Drills

THE illustration shows one application of the hammer drill to quarrying operations. In this instance, four Model 21 Waugh Turbros are being used, mounted on derricks, for drilling holes 30 feet deep finishing at 2 inches diameter.

The portability of the derrick facilitates quick set-ups and steel changes, and greatly increases the daily overall footage.

For deep holes of larger diameter, the Model 34 Waugh Turbro is recommended. Using the Model 34, one property is securing a daily footage of 200 feet, holes 40 feet deep, finishing at 3 inches.

**THE DENVER ROCK DRILL MANUFACTURING COMPANY**

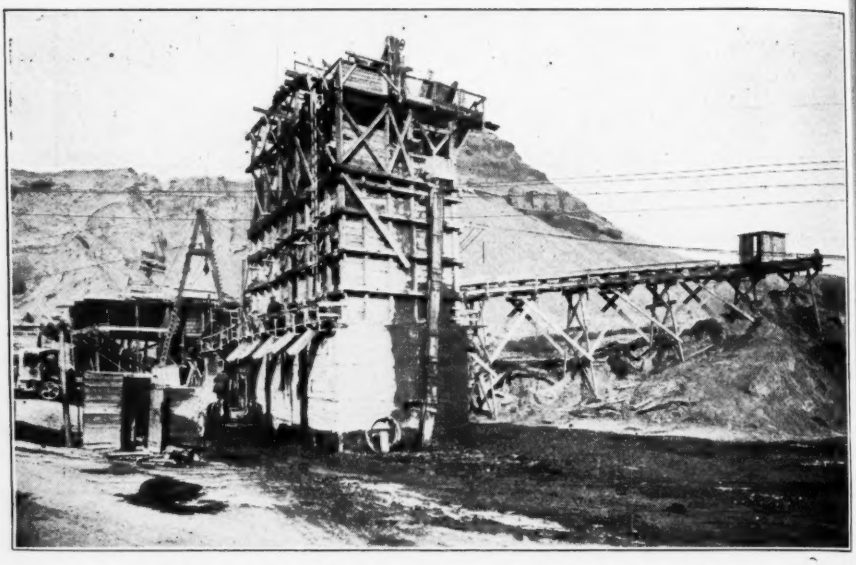
**DENVER COLORADO**

Rock Drills, Drill Steel Sharpeners and Hole Punchers, Portable Hoists

San Francisco, Dubuh, Knoxville, Pottsville, Scranton, Joplin, Birmingham, Mexico City, El Paso, Wallace, Butte, Lima, St. Louis, Salt Lake City, New York, Santiago, Seattle, Pittsburgh, Houghton

ROCK WAUGH DRILLS

Canadian Rock Drill Company, Limited, Sole Agents in Canada, Montreal Quebec, Cobalt Ont., Nelson, B. C., Vancouver, B. C.
The Denver Rock Drill & Machinery Company, Limited, Sole Agents in South Africa and Rhodesia, Southern Life Building, Johannesburgh, Transvaal, S. Africa
Andrews & George Company, Sole Agents in Japan, Tokio, Japan
Allied Engineering, Limited, Melbourne, Australia



Sand and Gravel Plant, designed, built and installed for Albany Gravel Company, Albany, N. Y. Capacity 400 yards per day.

# Plant Efficiency is—proper design, co-ordination

To those who are planning to build and equip rock crushing or sand and gravel plants, or those who are considering new equipment or plant changes, the plant designs, machinery and quality of service offered by our Engineering Department will prove extremely valuable.

Because no two pit or quarry operating problems are indentical, your plant and equipment, to give maximum service results, must be designed and built to meet exact local conditions. Our Engineering Department, thru its years of practical experience, has that facile comprehensive knowledge of principles that produces the most advantageous and most effective type of plant and arrangement of equipment possible under the circumstances.

This is the sort of service that enters into all the plants designed and furnished by us. It is your guarantee of genuine efficiency. In our plants the different departments co-ordinate properly and the equipment performs faithfully under all conditions.

Full information on our plants and equipment is contained in Crushing Machinery Catalog K. A. U., or Sand and Gravel Machinery Catalog 5-A. Both will interest you. Sent on request without obligation.

## THE GOOD ROADS MACHINERY CO., Inc.

KENNETT SQUARE, PA.

49TH AND HALSTED STS., CHICAGO, ILL.

# TELSMITH
## GRAVEL PLANT
## SNAP-SHOTS

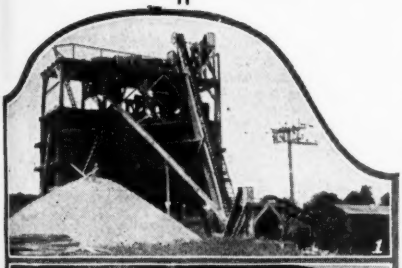
**TELSMITH PRIMARY BREAKER** (plate 3, bird's-eye view) is the master device for crushing gravel boulders. It exerts the full stroke on the big fellows that need the long pinch. Its steel frame, steel crown, unbreakable shaft, compact structure, force-feed lubrication —these features are milestones in the development of modern crushing practice. The Telsmith Primary Breaker is **guaranteed against breakage, even by tramp iron.**

**TELSMITH PLATE FEEDER** (plate 2) steadies the load on crusher, conveyor and screen. The stroke is adjustable to change the rate of feed. By preventing overloads, it improves the product, cuts maintenance expense, increases daily tonnage.

**TELSMITH SAND TANK** discharges clean, de-watered sand, as pictured in plate 5. It allows only 5% of free moisture to escape into the bins. This tank works just as reliably as the power plant of an ocean liner. Requires no power, no labor—not even supervision.

**TELSMITH WASHING SCREEN** (plate 4) scrubs and sizes the gravel in one cylinder, using a minimum of water, floor space and head-room. It saves almost its entire price in the reduced cost of transmission machinery and storage bins.

**TELSMITH ENGINEERING SERVICE** can't be photographed but is equally important. The best gravel plant will fail unless crushers, conveyors, screens and tanks are skillfully mated and intelligently combined into a single operating unit. One misplaced or undersize unit will impair the work of the whole outfit. Submit your problem to Telsmith engineers who have **specialized in quarry and gravel plant problems for eighteen years.** Your machinery will be designed, built, co-ordinated, balanced and guaranteed by the Telsmith organization. No "buck passing"—Telsmith stands behind the whole installation from crushers to bin gates. Glad to send you catalog No. GP-15. No obligation.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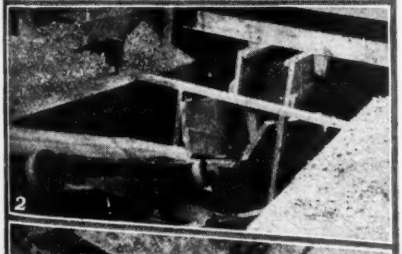
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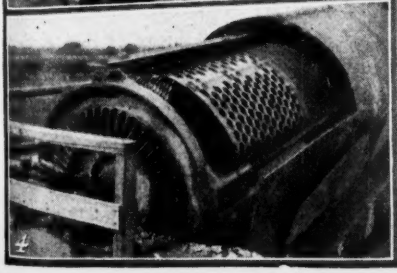
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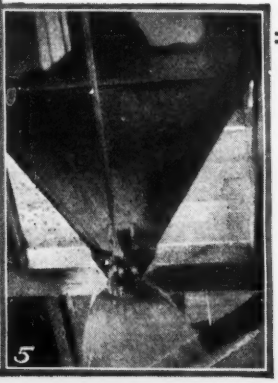
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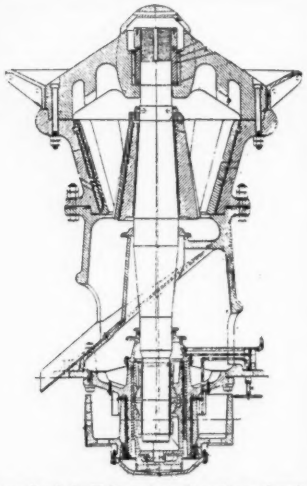
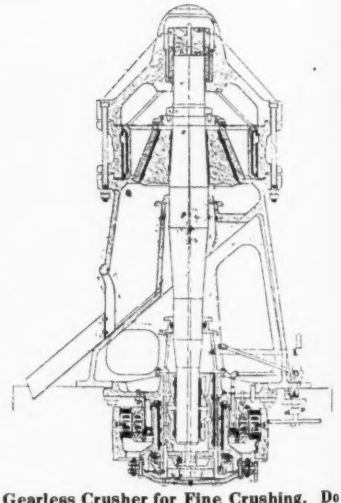
3—Practically no wear on anything but head and concaves.
4—Short shaft and saving in head room with packed dust collars.
5—Shaft reinforced with self-locking head so that it cannot break where 90% of shafts have broken.
6—Can be driven right, left, or standard, as sent from shop.
7—Eccentric is turned by flexible coupling attached to pulley, which prevents side thrust and heating, as in geared crushers.
8—Ball and socket eccentric, self-aligning, eliminating friction and heating. Runs for years without attention.
9—Positive circulating oil system through filter and cut geared oil pump.
10—Made in our own shop by experts, trained for the job.
11—It is a crusher with the trouble left out. See it in operation, and you are unfit to listen to any geared crusher salesman. In fact, if you are near one of his machines, you can't hear him, if you are so inclined.
12—Our fine crusher does the work of 4 geared crushers.



**Standard Ball Bearing Gearless Crusher Sizes No. 1 to No. 60—Weights 1,000 to 900,000 lbs.**



**Gearless Crusher for Fine Crushing. Do not be deceived by Vertical Concaves; that is not what makes a fine crusher.**

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3—Greater discharge opening and stronger construction.

4—Machine can be made either regular drive, right hand or left hand, by simply locating the bearing in the proper opening.

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8—Dust proof.

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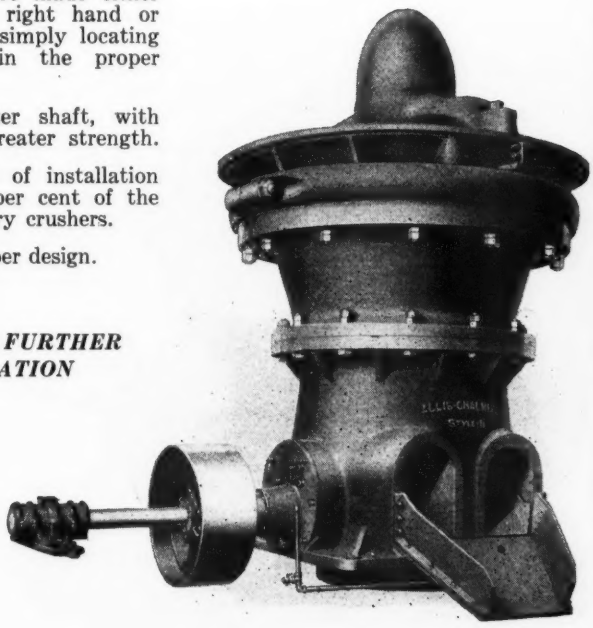

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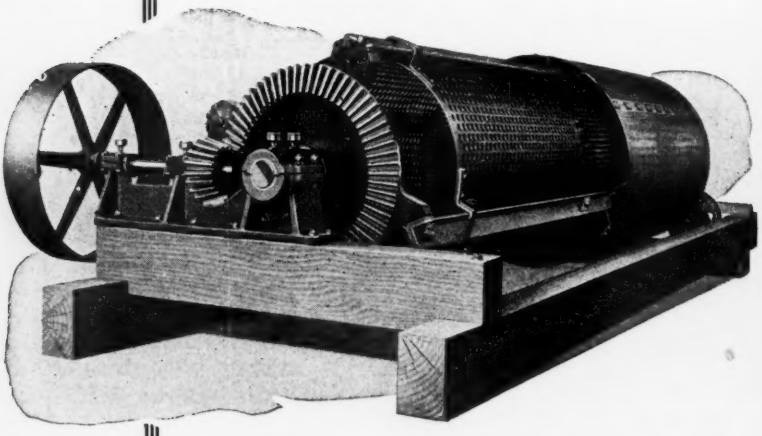

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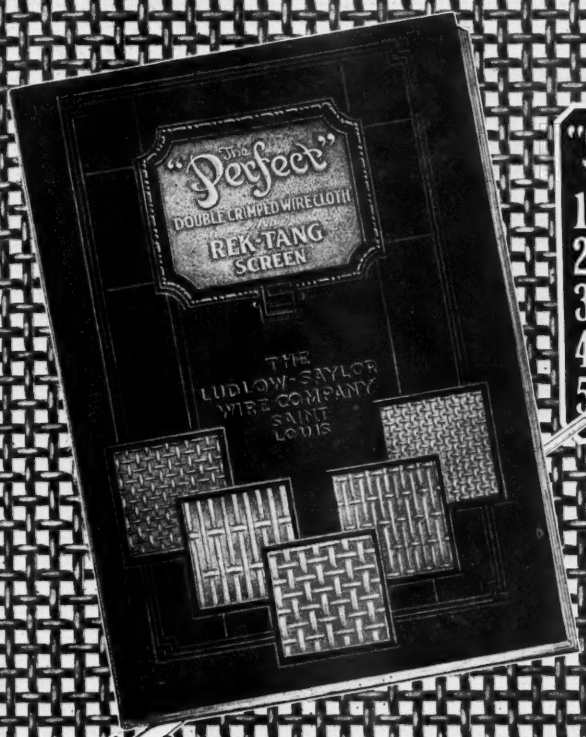


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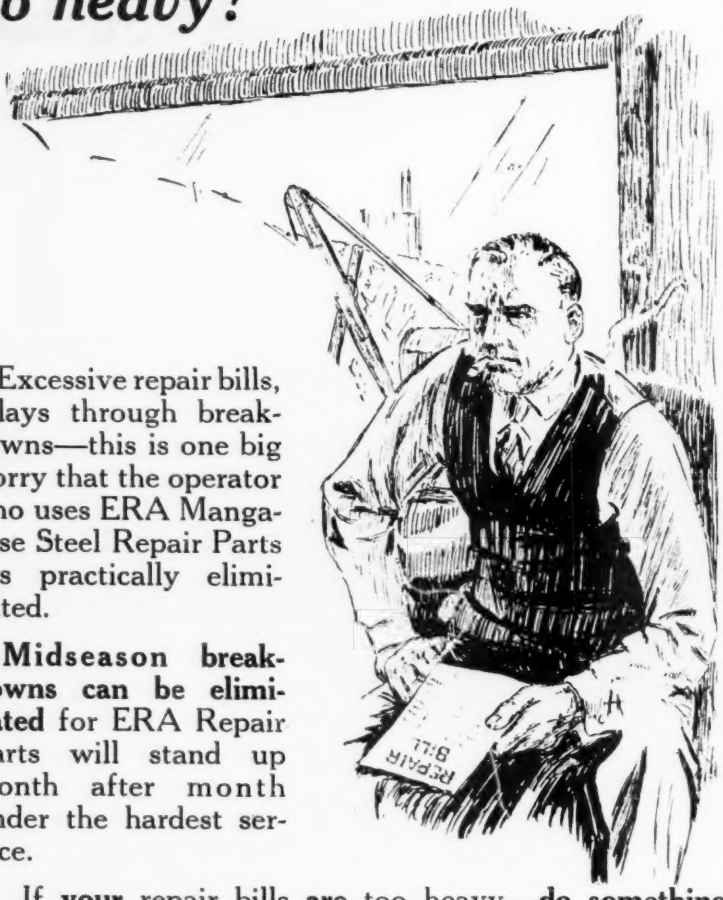
# *Do you find your repair bills too heavy?*

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# What is Manganese Steel?

**Question 1:** What is Manganese Steel?

**Answer 1:** Manganese Steel is an iron carbon alloy containing 10.00 to 14.00 per cent Manganese.

**Question 2:** Is Manganese Steel hard?

**Answer 2:** Its hardness is not that of tool steel, but rather a toughness so extreme as to resist even the action of the best tool steel.

**Question 3:** Is Manganese Steel brittle?

**Answer 3:** Right after being cast before it has been reheated and quenched, Manganese Steel is too brittle for any practical purpose. Proper reheating, however, gives it its quality of tough ductility for which it is noted.

**Question 4:** Why is Manganese Steel tougher than any other metal?

**Answer 4:** The well-knit extremely cohesive structure accomplished in the annealing and quenching process, is the reason for the toughness of Manganese Steel. This toughness is increased through use in the rigorous functions in which Manganese Steel is employed in the various industries.

**Question 5:** What gives Manganese Steel its qualities to resist abrasive wear?

**Answer 5:** The characteristic of becoming increasingly firmly set in its structure in response to attack, gives Manganese Steel its power to resist abrasion. The hardness increases with the severity of the contact.

**Question 6:** Why will it stand shock loads?

**Answer 6:** Having a ductility similar to soft steel and being extremely elastic, Manganese Steel is able to receive extreme shocks under which ordinary steel would break down utterly.

**Question 7:** Can Manganese Steel be used in places that are hot?

**Answer 7:** Manganese Steel can be used to advantage in places that are hot if the temperature does not exceed 650 degrees.

**Question 8:** Can Manganese Steel be machined?

**Answer 8:** Manganese Steel cannot be machined by the ordinary machine too methods as the action of the tool on this metal only increases the hard toughness as the metal resists the penetration of the tool.

**Question 9:** What uses has Manganese Steel?

**Answer 9:** Wherever metal that must resist extreme shocks and abrasive wear is required, Manganese Steel is the metal to use.

*There are other features of Amsco Manganese Steel that you should know. Write for our Manganese Steel Bulletin. It gives full information.*

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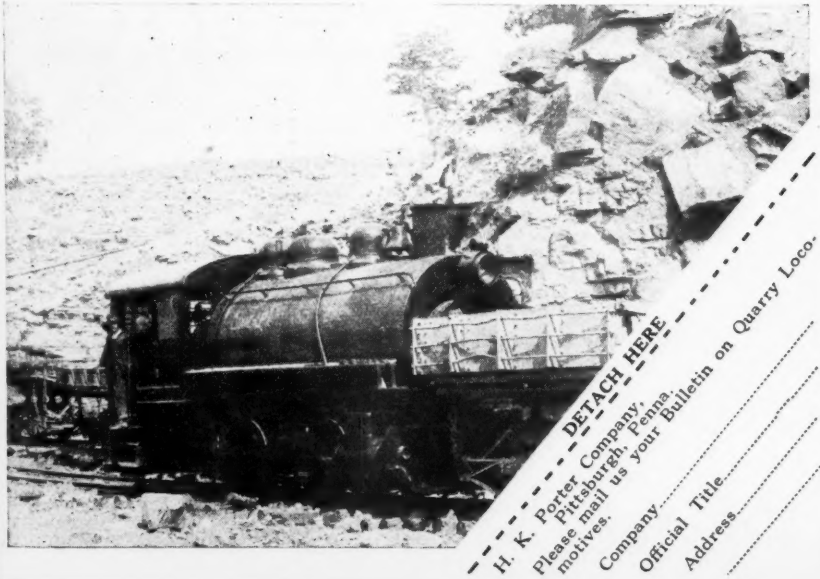

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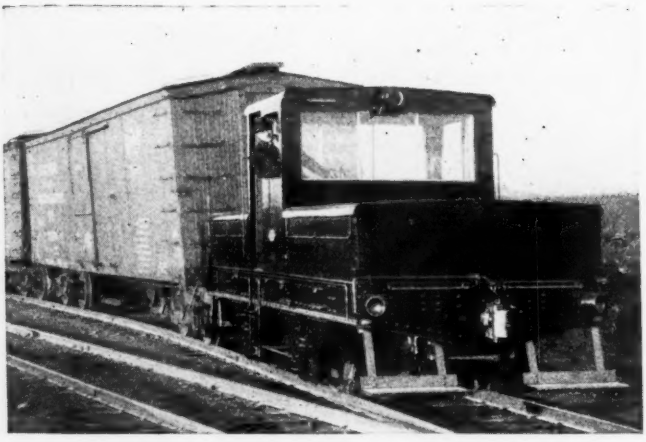

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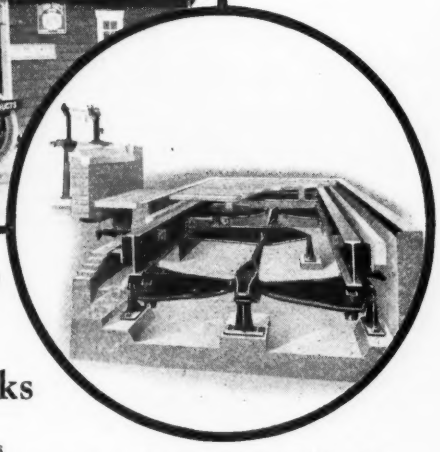
*Note rugged railroad track scale style of construction*



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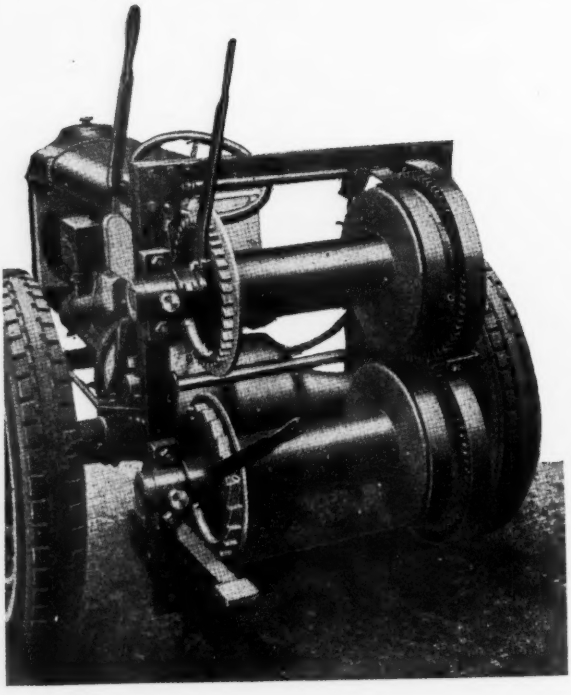

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**Pit & Quarry, Rand McNally Bldg., Chicago, Ill.**

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- ☐ Dippers
- ☐ Draglines, Cableway
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- ☐ Dredges, Dipper
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- ☐ Nozzles, Suction Screen
- ☐ Oil Burners
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- ☐ Pulverizers, Ring
- ☐ Pulverizers, Roll
- ☐ Pump Repairs
- ☐ Pumps, Drainage
- ☐ Pumps, Dredging
- ☐ Pumps, Sand
- ☐ Pumps, Water Supply
- ☐ Pyrometers
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- ☐ Rope, Manila
- ☐ Rope, Wire
- ☐ Sand-Lime Brick Machinery
- ☐ Scales, Automatic, Conveyor
- ☐ Scales, Track
- ☐ Scrapers, Power
- ☐ Scrapers, Team
- ☐ Screening Equipment
- ☐ Screens, Perforated Metal

*(See other side)*

- ☐ Screens, Rotary
- ☐ Screens, Vibrating
- ☐ Separators, Air
- ☐ Separators, Gypsum
- ☐ Separators, Magnetic
- ☐ Separators, Sand
- ☐ Sheaves
- ☐ Shovels, Electric
- ☐ Shovels, Gasoline
- ☐ Shovels, Steam
- ☐ Speed Reducers
- ☐ Steel Barrels
- ☐ Steel, Drill
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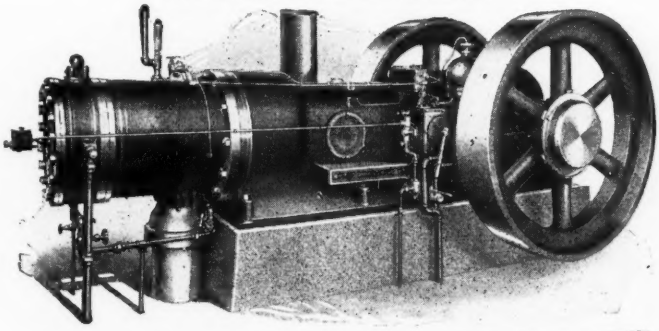

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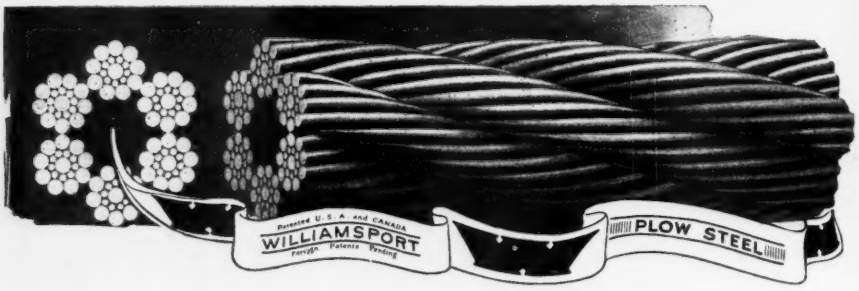


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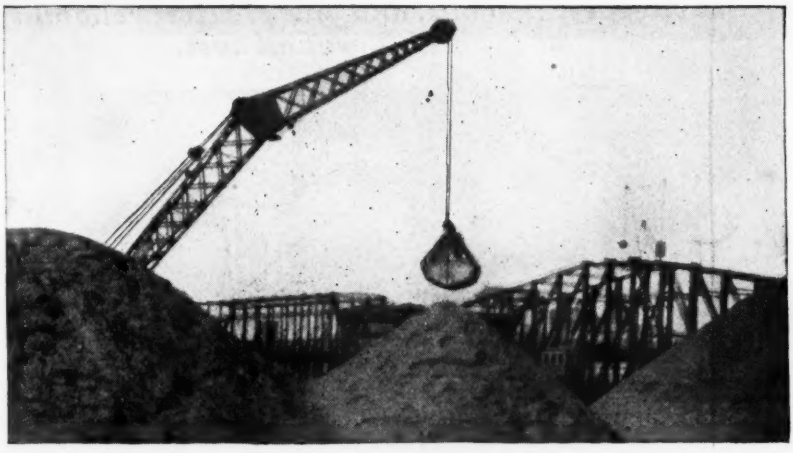

Clam Shell Bucket

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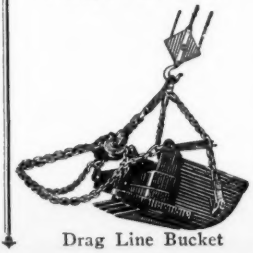

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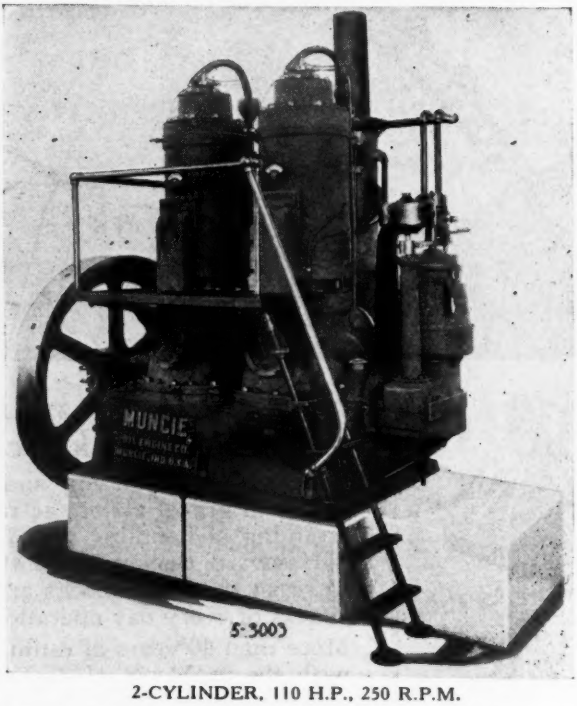


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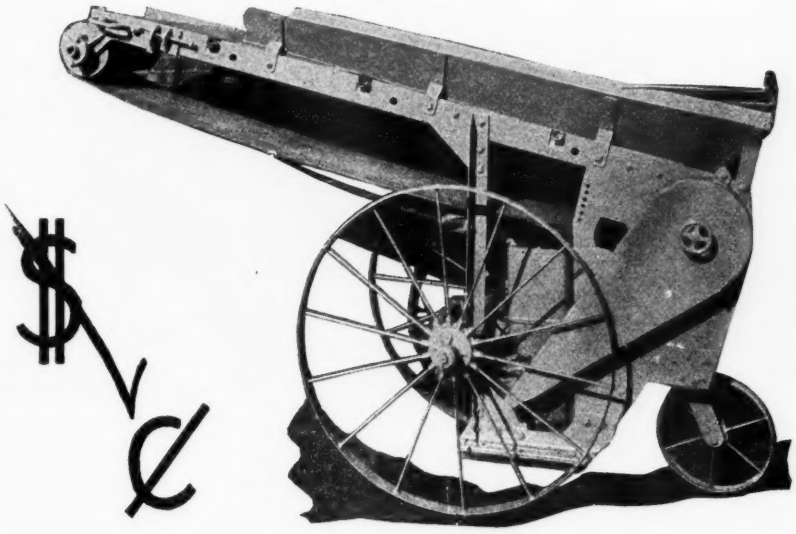

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# Pit and Quarry

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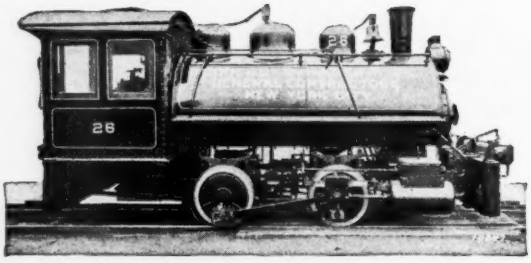


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# Pit and Quarry

*A Semi-Monthly Publication for Producers and Manufacturers of Sand, Gravel, Stone, Cement, Gypsum, Lime and Other Non-Metalic Minerals.*

VOL. 10 CHICAGO, ILL., JUNE 1, 1925 No. 5


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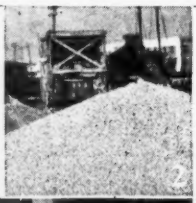
2.—Barber - Greene Conveyors building up stock piles for the Tampa Coal Co.



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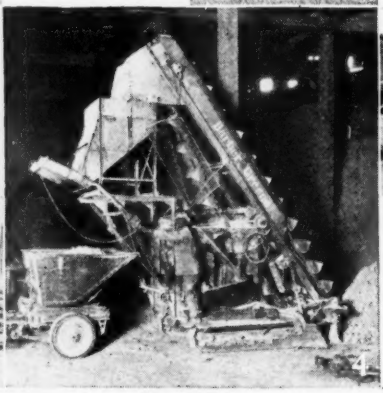
3.—A Barber-Greene type "N" Conveyor unloading bone from beneath a hopper-bottomed car for the Pacific Bone, Coal and Fertilizer Company.



4.—The Barber-Greene Bucket Loader that sent twelve wheelbarrows into the junk pile for the Newark Plaster Company.
5.—A Barber-Greene type "N" unloading cars from a track hopper.

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Pit and Quarry

Vol. 10 Chicago, Ill. June 1, 1925 No. 5

# Regulating Fatigue

CONSIDERED as a machine the human being has a definite amount of energy which can be used for purposes of production. The problem of utilizing the human machine involves a study of fatigue. Physicians explain fatigue as a condition caused by the formation of a poisonous substance thrown off by the muscles. When this toxin is produced faster than the organs of the body can get rid of it, it enters the blood and poisons the system. This means that the body is not working efficiently, that the human machine needs attention. A tired muscle requires a greater stimulus to make it work; it is inefficient. If human beings are to be induced to exert themselves in industry, their minds must be persuaded to send out impulses to the muscles. As fatigue increases, there is greater reluctance to urge the muscles to respond. To maintain a high degree of efficiency with tired workers requires very great incentives. If the fatigue is diminished, production is correspondingly increased.

Executives are studying this problem of fatigue and are reaching conclusions that are of great value to the industry as well as to the employees. Rest periods at regular intervals will take care of the problem and increase the value of the worker. The muscle in the body which does the most work is the heart. Its constant functioning with no fatigue is due to the automatic rest period which follows each contraction. Establishing the logical relation of rest and recreation to exertion constitutes the problem for the executive. It is not an easy problem, but it is an exceedingly practical one.

Fatigue is not proportional to the results but to the energy exerted. Much of the energy may be wasted. If the physical processes are not controlled by adequate mental conceptions, awkward movements result which produce high fatigue per unit of production. If a process is not understood by the worker, he struggles over it mentally with an increased and unnecessary amount of fatigue. In all work native aptitude, training, and the facility of habit are important factors in reducing fatigue. As the work of an individual proceeds, effort becomes more and more easy, and production increases. Then production slowly reaches a maximum and for a period conditions remain uniform. Decline follows as effort and strain become intensified until the work is continued only by the energy of the will. If exhaustion becomes complete, work ceases.

Moderate degrees of fatigue are not at all harmful and can often be relieved in interest and enthusiasm. If fatigue reaches the point of overstrain, it is harmful to the industry as well as to the worker. It is a principle of economics that labor should cease at a point where society begins to suffer a greater loss through the breakdown of the laborer than the gain resulting from the product of his exertion. If the employee is so fatigued in a work period that he is not in good condition at the beginning of the next work period, the industry suffers. The results of compounding fatigue for indefinite periods are often serious. Not only poor work follows such a condition, but accidents are more likely to occur.

Since fatigue may be the result of the mental attitude of the worker, it is well to give careful consideration to all methods of making work interesting and enjoyable. The most successful human activity is accomplished with some sort of rhythm. The greatest enjoyment and efficiency is reached when a certain rhythmic motion is attained. In every line of work there is a certain rapidity and repetition of motion and alternation with rest that produces the greatest result. One has but to watch men

shoveling to find proof of this fact. A workman who gets the swing of his work will go on for hours performing exertions without fatigue. Rhythm satisfies a deep characteristic of human beings. Hence the more nearly any kind of work is reduced to a proper rhythm, the easier and more pleasurable it becomes. All motions involved in a piece of work should, therefore, be arranged so that they fall into the most effective rhythm. Of course, in industry the rhythm needed to secure the greatest production is not the main consideration. Machines are geared to certain speeds; operations follow other operations; and the flow of materials governs the speed with which various operations must be performed. It is apparent, however, that certain natural rhythms of work and rest are the logical results of natural conditions. Certain changes of work and changes of operation can be planned to give the relaxation that is necessary if undue fatigue is to be averted.

The more skillful the workman, the less fatigue is experienced. The untrained worker must be constantly thinking of his work. Each action requires a conscious nervous impulse which does not always go to the proper muscles. Until the movements become habits, he will make many unnecessary motions, which are wasteful, wearying, and unprofitable. Therefore it is important to train workmen so that all the energy expended is applied directly to the job. All wasted energy is a financial loss. Unnecessary lifting of material, shifting of loads on a machine, picking up and putting down articles unnecessarily cause unproductive fatigue and waste the energy of the worker.

Many executives find that it is good policy to retain the older men as far as possible. The value of stability and training, the expense of turnover, and the decreased liability of older workers to accidents warrant this policy. These men have learned much through experience and can be utilized in aiding the new employees in adjusting themselves to the work. The loyalty of the older men will aid in promoting group interests. Their mastery of the technique of the job can be passed on to new men with a minimum amount of loss due to breaking them in. They have caught the swing of the job and can impart their knowledge to others.

A careful estimate of the waste due to fatigue has been made, and the conclusion reached is that fatigue decreases the productivity of American labor $7,000,000 daily. Fatigue is also held responsible for a large percentage of the accidents, sickness, and discontent which have a serious effect on production. A part of this fatigue is attributed to bad lighting, poor ventilation, wrong postures of workmen, and a fear of accident. Of these the fear of accident causes a lowered efficiency. In 1909 there were 23,000 fatal accidents recorded; there were 575,000 injuries causing disability for four or more weeks. Minor accidents brought the total during that year to 3,000,000. The estimated loss in days of labor was 296,000,000. At the rate of $4.00 a day the estimated loss was $1,184,000,000. Such statistics show that loss due to accidents in American industry are vital in actual cost as well as in the effect on the workers. The relation of accident to fatigue is a problem of interest to all executives since it is a problem involving one of the greatest possibilities for waste.

One of the largest forms of preventable losses in industry is due to unnecessary sickness. The rate of sickness, like the death and accident rate is being steadily reduced. Statistics show that each worker loses an average of about seven days a year through sickness. A few years ago this average was nine days. Authorities on the subject believe that proper health supervision would effect an annual saving to industry, through improved health conditions of $1,000,000,000, above the cost of the service. The problem is so closely connected with that of fatigue that a study of one involves the other. There has always been contention regarding the length of the working day, and there is still sharp difference of opinion on the subject. There is a growing tendency to settle the difference by actual analysis of the facts rather than by threats or strikes. What length of working day will insure the largest production, the longest working life, the cheapest product and the most efficient operation of industry is the question.

Conclusions should be reached only after all elements, human, mechanical, social and industrial have been analyzed on a scientific basis.

# Technical and Promotional Problems Discussed by Lime Manufacturers

## Convention Held at Briarcliff Manor, N. Y., May 26, 27, 28, 29, 1925
## Chemical, Agricultural and Construction Progress Reported

BRIARCLIFF LODGE at Briarcliff Manor, which is only 29 miles from New York City, proved to be an ideal setting for the Seventh Annual Convention of the National Lime Association. The convention began on Tuesday, May 26th, with a board of directors meetings at 10 o'clock. At 11:30 the members met in executive session at which the plans for the convention were explained.

Throughout the convention the mornings were devoted to Association affairs while the afternoons were given over to golf, tennis, quoits, and other pleasures. Tournaments in golf, tennis, quoits and bridge were held with prizes donated by the Valve Bag Company of America. As in the past the Valve Bag Company entertained those in attendance at the convention at a dinner on Thursday evening. The members of the National Lime Association have come to look forward to these banquets each year as one of the outstanding pleasures of their annual meeting. The cordiality and good will prevailing between the lime producers and the Valve Bag Company is nowhere equalled in any of the other non-metallic industries.

Dean E. J. McCaustland, of the University of Missouri, addressed the convention at lunch on Tuesday on the subject of Lime in Dirt Roads. This paper is presented in full elsewhere in this issue. It is interesting to note that should lime affect the hoped for results in dirt roads, a tremendous market will be opened up. However, at the present time Missouri is the state most concerned with the problem of "impassable" roads, and Missouri is not in a position to spend any money and possibly will not be for some years to come. The experiments with lime in dirt roads are being conducted cautiously and at the time of this convention the final results were not available.

On Tuesday evening the second annual research conference was developed into a round table meeting of lime technical men, plant chemists and superintendents, and manufacturers. Problems connected with manufacture were more or less emphasized with some discussion of research programs and problems. The following list of questions was submitted as suggested.

1. What specific quections do the representatives of the manufacturers have to ask the Research men?
2. What specific questions do the Research men have to ask of the representatives of the manufacturers?
3. The following are some of the active research problems. What are your comments or suggestions?
   (a) How may the sand carrying capacity of a lime be determined?
   (b) What conditions or properties determine the putty yield of limes?
   (c) To what extent does the colloidal content of a lime affect its properties?
   (d) What conditions and factors determine the colloidal content?
   (e) How can colloidal content be measured?
   (f) Does the magnesia of a lime hydrate? Under what conditions?
   (g) What factors determine the settling rate of lime sudges in causticizing?
   (h) What properties determine the value of lime for bleach manufacture?
   (i) How can the so-called "after precipitation" met with in water softening be prevented?
   (j) What is the best method for determination of quicklime in hydrated lime?
   (k) What is the best method for determination of available lime?
   (l) Should analyses be reported on "as is" or on "non volatile" basis?
   (m) What facts must be observed in sampling lime? Best

method of sampling lime at the plant?

(n) What relation does fineness of a hydrate have to its value for addition to concrete?

(o) What relation does fineness have to soundness?

(p) What relation does soundness have to value of lime for concrete?

4. What specifications should a hydrate for concrete be required to pass?

5. What are the relative values of screening and air separation processes for finishing a hydrated lime?

6. What requirements as to waste should a lump of lime meet?

7. What temperature of slaking water should be specified?

8. Should sand be added to a hot lime-putty?

9. Should all shipments of lime be accompanied by directions for handling, slaking, sanding, etc?

10. How much does the non-uniformity of commercial lime depend upon imperfect burning; both overburning and underburning? What are the best conditions for elemination of these defects? What are other causes for non-uniformity?

11. What is the best method for determination of the temperature of a kiln?

12. What effect does the rate of heating of the stone have on the properties of the lime?

13. What are the best methods for producing a long mellow flame?

14. What specifications should coal for lime burning be required to meet?

15. Can the hydration of calcium oxide be accelerated or retarded? What effect does this have on the hydrate? Have these facts any practical applications?

16. What conditions of manufacture tend to reduce the available lime content of a hydrate? How can the available lime content be increased?

17. What is the best method for determining total water in a lime?

18. How can the excess total water over the sum of the free (115°C) and calculated combined water be explained?

19. How can the occasional stickiness of a hydrate be explained?

20. Is the magnesia of a lime available for chemical reactions such as ammonia distillation, etc?

21. Is hydrated lime ever unsatisfactory as an addition agent with insecticides for dusting? If so, how can it be made satisfactory?

22. Can lime be used for marking grass tennis courts?

23. What is the best form of lime for addition to mineral supplements for animal feeding?

24. In what way does the storing of lime affect its properties?

25. What uses of lime need most promotion during the next year?

26. What new uses for lime can you suggest?

27. Should the Headquarters Laboratory have facilities for analitical work for members?

Mr. George B. Wood, President of the National Lime Association, presented the opening address on Wednesday morning at 10 o'clock. Mr. Wood reviewed the progress of the Association during the past two years and urged that the research work of the Association which has proved such a benefit be continued. The progress of the Association has shown a tremendous stride in the manufacture of lime. Mr. Wood, who retires as President of the National Lime Association on July 1st, justly deserves all the appreciation that the lime industry can bestow on him.

Mr. Burton A. Ford, General Manager of the N. L. A., presented his report also at the Wednesday morning session. Mr. Ford reported that there has been a steady growth in membership during the past two years, there being about 20 more members at this time than on July 1st, 1923.

Mr. E. B. Besselievre, Sanitary Engineer, The Dorr Company, New York City, addressed the convention on Wednesday morning on, "Developments in the Lime Treatment of Trade Wastes." This subject was treated in a preliminary way at the convention last year. Mr. Besselievre predicted an increase in the use of lime in the treatment of trade wastes in the coming year. Lime was discussed as a precipitating and coagulating agent, as a neutralizing agent, as an agent to better the physical condition of sludge, as an alkali and as an electrolyte and chemical precipitant. Among the advantages mentioned were the softening of the water, the killing of bacteria, the clarifying of the water, and the absorption of color when lime is added. Mr. Besselievre described the usual

process of treating trade wastes with lime.

At the executive session on Wednesday morning the Chemical Department presented a complete review and summary of the lime plaster investigations which have been continued over a period of approximately three years. A report was submitted to the Board of Directors containing descriptions of specific mixtures with specifications and directions for their production and test, and definite recommendations were made as to production control tests and sales promotion of these materials.

At the same executive session Mr. J. W. Stockett, Assistant Chemical Engineer, presented a review and summary of what has been done in the laboratory and at the Association's plant at York, Pennsylvania. The entire problem was turned over to a committee composed of George B. Woods, Chairman; Charles Warner, J. J. Porter, J. M. Deely, and John Kling. The future of the problem will be in the hands of this committee.

Mr. Charles M. Cadman, President, Pacific Lime and Plaster Company of San Francisco, California, addressed the Association luncheon on Wednesday. Wednesday evening the Association convened to see a moving picture entitled, "The Age of Lime," which was presented by Mr. Henry M. Camp, Manager, Eastern Division, N. L. A.

The picture was produced under the auspices of the Commercial Development Department of the Baltimore and Ohio Railroad Company by Dr. George B. Shattuck, scientist for the Railroad, with the co-operation of the National Lime Association. Starting with the blast in the quarry and the wrestling of the raw material from Mother Earth, the manufacturing scenes of the picture passed through the various stages of production until the loading of the freight car with the finished product was reached. From then on the picture was devoted to the principal uses of lime in the agricultural and structural fields of consumption of the product. In agriculture, the picture began with the quantitative lime requirement test of the soil in the field to determine its lime hunger and ended with the crop protection of the growing plant with the use of the dust and liquid sprays of lime in combination with various poisonous elements.

The beneficial effect of lime as an admixture to concrete to improve its workability and density, which is conducive to increased strength, was shown. The economy accruing in the placement of the mass; the predomination of lime in the composition of brick mortars to insure proper economic control of the natural white joint so desirable with the several shades of brick in giving a contrast that is pleasing and artistic; the beautiful stucco textures made possible through the plastic nature of lime and the hardness of surface of good lime stucco; the modern machine method of mixing mortar for plaster on a large scale; the correct method of slaking lime; all stages of the plastering job on concrete, hollow-tile, wood and metal lath backings and the details of fine workmanship in the accomplishment of a first class finish coat of plastering; a striking example of perfect "keys" on wood and metal lath backings for full security of the base coats; and the completed stucco house and the brick house are some of the "shots" that have been carefully planned and photographed in the natural state so as to bring out the characteristic qualities of lime in its prominence as a structural material.

The picture was begun in 1923; it is not yet finished and may not be for some time as new scenes are constantly being added. The first shots embrace scenes of the work of the Soil Improvement Train conducted by the B. & O. Railroad Company in the summer of 1923, in which the Association cooperated. With the inspiration to go further into the subject of the industry of lime, it was decided to make a true-to-life depiction of the production and use of the product and to build the picture gradually as time and opportunity would permit on the part of the Railroad Company and the Association. The shots were made in New York City, Brooklyn, Chicago, District of Columbia, West Virginia, Ohio and Maryland. Approximately 150 different scenes were recorded, of which a number were excluded from the final make-up of the picture as impractical or because of defective lighting. The N. L. A. has not been able as yet to reach the taking of pictures on the major uses of lime in chemical and industrial plants, due

largely to lack of time. It is also desirable to keep the general picture within the capacity of 4,000 feet, or that amount of footage which can be shown in continuous operation not to exceed forty minutes. In the make-up of the picture it is so laid out that for a strictly agricultural audience the four reels of approximately 1,000 feet each, constituting the entire picture, may be divided into two reels of about 2,300 feet comprising the production and farming scenes. In the case of a construction gathering, the picture may be limited to two reels of about 2,700 feet to include production and structural scenes. If organizations, such as the Rotary or Kiwanis Clubs may desire only the production feature, one reel of about 1,000 feet can be provided requiring only about twelve minutes.

As now constituted the finished picture of four reels and approximately a total of 4,000 feet of film may be considered primarily as a popular instructive feature in trade extension work for lime. It is of interest both to farming and to construction gatherings, to the commercial audience and to the general public.

The report of the chemical activities was presented by Mr. G. J. Fink, Chemical Director, at the Thursday morning session. This report was quite complete, and during the reading of the report your editor was impressed with the fact that the N. L. A. can do for its individual members what they individually could not afford to accomplish for themselves. Mr. Fink is able to draw on pools of accumulated human effort and to present the results to each member of the Association. The following extracts from Mr. Fink's report are of interest:

"Requests from individual members and from the division organizations for analysis of limes, plasters, concretes, stuccos, waste by-products, and for control tests for determination as to whether products comply with A. S. T. M. requirements have taken practically the entire time of one man and this situation has helped more or less to sidetrack work which we have had outlined in connection with what we consider the more fundamental investigations such for example as the completion of the work on properties of commercial lines. Over 40 complete analyses of plasters and concretes and about 35 complete analyses of limes and stones have been made. This in addition to the very large amount of analytical work required in connection with the plaster problem.

"This leads us to remark that if this type of analytical service is to continue and to increase it should and must be especially provided for. Such service to member companies we believe should be made possible and there is no question but that it is essential to the proper functioning and efficiency of the Headquarters promotion work and the Division field activities.

"However, in spite of the increased demands on our time, we have at odd times been able further to develop certain methods of test and to devise certain new ones. Some time has been spent on methods for determination of available lime, carbon dioxide, free water, etc. and sufficient facts and data have been accumulated to justify the publication of a number of papers which will appear just as soon as we can find the opportunity to get them into proper form.

"Numerous questions arising in connection with the various uses of lime have been answered and we have thereby been enabled to give very practical service to lime consumers.

"The increase in requests from members and from users for information and help on manufacture and use has been very marked during the past year. Our office is being utilized as a clearing house for information on numerous manufacturing problems, fuel, proper methods for burning for particular uses, specifications for uses and suggestions for new fields.

"As you are already informed, the research and investigational work of the Association is divided between the Headquarters Laboratory and Fellowships which are maintained in various educational and governmental institutions. Prof. Withrow of Ohio State University and Prof. Haslam at Massachusetts Institute of Technology both have a number of men interested in lime problems in addition to the one man in each institution who is specifically assigned to the fellowship work.

"At Ohio the efforts have been concentrated on the problem of trade wastes and the work has been car-

ried from the Laboratory to the field by means of which arrangement the Fellowship men has been co-operating with plants in that vicinity and has observed and has advised in connection with installations using lime in the treatment of waste plant-effluents.

"An investigation of the solubilities of commercial limes have been continued at N. I. T. and it has been found possible there to make definite practical application of a number of the facts developed.

"In addition to the Fellowship work just described, we are also co-operating with fourteen other educational institutions and other organizations in investigations involving manufacture, properties or uses of lime. The subjects of these researches include a very wide range, among which might be mentioned: storage tests on lime products in various types of containers, study of the compounds of lime with sulphates, carbonates and aluminates, methods for the separation of the lime and magnesia of dolomitic lime, preparation of special insecticides from lime and the use of lime as an admixture in insecticides for special purposes as well as a carrier of liquid insecticides, preservation of wood with lime compounds, the use of lime in trade wastes, methods for lime analysis, lime statistics, etc.

"We have also supplied one of the larger technical societies with lists of problems of the lime industry and these have been distributed to all research members of the Society. Our problems are thus brought to the attention of technical men and through these suggestions we received requests for co-operation in investigations from a large number of outside laboratories. The outlines of practically all such investigations have been decided upon after a conference between our office and the directors of the laboratories involved.

"Our activities in connection with the A. S. T. M. work has continued to consume considerable time but we believe that such time is profitably spent. It may be of interest to mention the fact that the 1924 A. S. T. M. standards include three standard specifications for lime for an equal number of uses and that the 1924 tentative standards include eight tentative specifications. Committee C-7 is at the present time working on specifications for nine other uses and it is to be expected that several of these will appear in tentative form within the next year. These include specifications for lime for glass, sugar, gas purification, insecticides, bleaching powder, leather, greases, ammonia distillation, and metallurgical operations.

"For those of you who are not so closely in touch with work which has been done on specifications it may be of interest to know that the Bureau of Standards has published specifications for lime for various uses for which there is no A. S. T. M. standard. These are as follows: Glass, Circular No. 118; Causticizing, 143; Sand-Lime Brick, 150; Ceramic Whiting, 152; Gas Purification, 189; Sugar, 207; Calcium Arsenate, 203. Those published by the Bureau of Standards for which Committee C-7 has already written specifications are Rag Cooking, 96; Sulphite Pulp, 144; Structural Quicklime, 201. Our office has been consulted by the Bureau of Standards and the Interdepartmental Conference during the preparation of all of these specifications and we have co-operated as best we could toward the development of a specification satisfactory to all concerned.

"In the development of specifications for lime we have laid down as a guide certain rules which we have attempted to follow. Our position has been that the minimum requirements should be only so high as to permit of satisfactory results with the lime specified. This must be so for two reasons, viz: First, so that no manufacturer should be prevented from selling lime with which results satisfactory to the user are being and can be obtained and, second, because economically it is wrong to require the use of a raw material which is better than is necessary because the cost of production and the price of the finished product are thus unnecessarily increased.

"Beyond these minimum limits the consumer should be allowed discretion and choice. It is for him to say whether he shall pay the higher price for the better raw materials and thus be compelled to charge the higher price for his product. Competitive conditions, local factors, efficiency of process, etc. all are factors in this decision.

"We are glad to note very increased interest on the part of lime manufacturers in the A. S. T. M. work and we hope that the list of

manufacturers members will be rapidly increased. This is one of the best reasons for the establishment of the position of lime as a chemical and for obtaining the consequent beneficial results for the industry.

Mr. Victor J. Azbe, Combustion Engineer of St. Louis, Missouri, prepared a very scholarly paper on Kiln Performance for presentation Thursday morning. This paper was so long and technical that Mr. Azbe discussed only a few phases of it. Pit and Quarry will publish this paper completely. The first part appears elsewhere in this issue.

Miss E. H. Roth, Secretary-Treasurer of the Sheboygan Lime Works of Sheboygan, Wisconsin, presented an address on "Association Literature" at the Thursday morning session also. Miss Roth's remarks were concerned with the uses of lime, the preparation of proper literature on lime and the distribution of this literature. A very significant point was voiced by Miss Roth when she said, "Had the manufacturers started the promotion of lime by means of advertising literature, such as we have today, about twenty-five years ago, the other products that have taken its place would not have succeeded as they have."

Dr. George K. Burgess, Director, United States Bureau of Standards, addressed the association at lunch on Thursday. His remarks were confined largely to the work of the Bureau of Standards.

Mr. R. C. Towles, Soil Technologist, N. L. A., presented his report Friday morning on the agricultural activities of the Association during the past year. The following extracts from this report are presented because of their interest to the industry.

"Of the total amount of money spent for agriculture, over 70 per cent has gone into research work. All of this research is being carried on in co-operation with state institutions over the country, some of it as fellowship work and some directly by the regular State College and Experiment Station employees.

"The close of this fiscal year will mark the end of the fourth year of the Tennessee fellowship, in which studies have been made of high calcic and high magnesic limes in amounts chemically equivalent to ground limestones of four separates. These various separates of raw stone have also been compared with each other. Depth of incorporation of all the liming materials has also been included in the project, and comparisons have been made between the effectiveness of amounts of lime varying from 250 to 2000 pounds per acre in both the upper and lower zones of the soil.

"During this month the tanks which have been used in these studies are being disrupted and samples removed to the laboratory, where the fifth and last year of the project will be devoted to laboratory checking and analyzing. As a result of these studies Dr. McIntire, under whose guidance this complicated work has progressed so smoothly, advises that it is now being grouped for final conclusions, and he has submitted to us an outline for the publication of 8 papers which he will prepare for the data obtained. Some of these results are very interesting, but Dr. McIntire has asked us to refrain from drawing hasty conclusions which laboratory findings later on may or may not substantiate, and we therefore make no definite statements at this time as to the benefit our industry may expect therefrom.

"Last year Director Ellett of the Virginia Experiment Station became sufficiently interested in one phase of our Tennessee project so that he desired to duplicate it. Through Dr. McIntire we arranged with the Virginia people to supply them with 31 additional lysimiters, which we have done. The purpose of this Virginia project is to compare the immediate applications of the amounts of lime ordinarily recommended with the accumulative system for making such additions, for the purpose of determining whether or not there is a sufficient amount of leaching and tenacious fixation of lime in the soil to permit a small application to desirably affect one crop in the rotation and at the same time to insure its absence for subsequent non-lime loving crops. Such a condition would permit of liming more freely on truck crop lands.

"The fellowship which was installed at the University of Wisconsin during our fiscal year of 1923-24 was provided for again this year. The object of this work primarily is to measure the worth of small applications of the burned forms of lime at frequent intervals as against the worth of the system of applying

large amounts of the slow-acting raw forms at less frequent intervals. Since the last Convention a representative of the Association has visited the Wisconsin institution in order to inspect the project. The progress of these studies are very well set forth in the following excerpt from a report by Dean A. R. Whitson, who is in charge of the fellowship:

"We now have under way work on essentially all lines under the project which were included in the project which were included in the original suggestions made by the Association. We are starting this spring a field on acid peat soil, thus giving us three good fields on that number of radically distinct soil types, all of which are distinctly benefited by lime. The emphasis is of course being placed on the practical field aspects in comparisons of he different forms of lime and especially in comparisons of small amounts of different forms and on those crops which in general show a maximum benefit from lime applications. Together with these studies, we are carrying on studies on the effects of lime such as Influence on Nitrification and Nitrogen Fixation, and on the Relation of Acidity to Lime Requirement. Since the field work was only started a year ago not much direct result was obtained from the field work that year, but we have every reason to expect more definite results during this second season since we shall have all of the crops involved growing on treated land.

"Plant house work parallel to that in the field has been carried on and we are getting rather definite indications that when applied in chemically equivalent amounts lime hydrate is more effective in promoting growth than limestone. We are also getting rather definite evidence that quick lime is more effective in increasing the rate of nitrification than is limestone in equivalent amounts, and that amounts of quick lime equivalent to 1000 pounds of limestone are quite effective in that respect, though the increase is not so great as when heavier applications are made."

"Three years ago a project was outlined in co-operation with the University of West Virginia whereby they agreed to make a very comprehensive study of maintaining and improving permanent pasture land. Our part was to furnish the lime. These experiments consist of a large series of plats that are treated with various fertilizing materials, half of each plat being limed and half unlimed, and so fenced in that part of each plat is grazed by cattle and part mowed and the growth of pasturage weighed. Flora counts on each of the plats are also included in the work.

"A representative of the Association visited the University of West Virginia last fall, and they have now furnished us with a report of the first two years results. They desire us not to publish anything until after the end of this season, at which time they intend also to publish results, but without making known any actual figures we are glad to report that 1500 pounds per acre of hydrate as a top dressing once in three years has proved to be more efficient than annual applications of either 300 pounds of acid phosphate, 100 pounds nitrate of soda, 8 tons of barnyard manure, or combined applications of acid phosphate and manure.

"The purpose of the fellowship at Nebraska is to determine the nature, extent and desirability of the effect of various liming materials on the physical properties of the soil.

"This project was started the latter part of 1923 and is under the supervision of Professors W. W. Burr and J. C. Russel. The University has not only augmented the efforts of our fellow on this project by allowing professor Russel to work right along with him but has gone to a great deal of expense in making available costly machinery and equipment for studying soil cohesion, adhesion, plasticity and other fundamental physical properties.

"Since the last Convention one of our representatives has visited the Nebraska people, and up to the present time two phases of the subject have been studied; first, the effect of liming materials on the reception and conservation of moisture; second, the effect of liming materials on the fundamental physical properties. In the former study a number of small plats were laid out in a field of uniform slope, and applications of various liming materials were made to the individual plats. At regular intervals moisture determinations were made on each plat and the indications are that hydrated lime at high rates of application per

acre lead to a considerable accumulation of available moisture in the second and third feet of the soil. Light applications thus far seem to have produced little if any measurable effect.

"In the latter study soils from different states where treated with different liming materials and kept in storage at optimum water content for two months. They were then subjected to a number of tests to determine the effect of the various treatments. Although the various materials used have had a flocculating or granulating effect, it has been found difficult to measure exactly the changes in cohesion, adhesion, etc., and in order to get at these properties more accurately a deviation has been made from the original outline and a special work is being done on a pure clay extracted from a soil of high clay content. Other studies now under way on this project are: (1) laboratory determinations on the effect of liming materials on the permanency of the granular structure, (2) observation of structural differences resulting from lime applications upon soils from various parts of the country and (3) various field plat studies on limed and unlimed soils located at Crete, Rockford, and Lincoln, Nebraska. The effect of lime on physical properties of all field plats is also being measured in terms of resistence to plow draft.

The report of the construction activities of the N. L. A. was presented by Mr. R. P. Brown, Construction Engineer N. L. A., also on Friday from Mr. Brown's report are of inmorning. The following extracts terest.

"The fellowship work this year has been very encouraging. Dean E. J. McCaustland from the University of Missouri has already discussed in considerable detail the work done under the supervision on lime in dirt roads at the University of Missouri and so a review of that work is unnecessary. The information secured there will undoubtedly prove to be the basis for a substantial increase in lime tonnage, particularly in the rural districts. The work on the sand carrying capacity of lime is also progressing nicely. The endeavor has been to determine when a mortar is over sanded and when it is under sanded. Apparently the use of less than 10 per cent of lime by weight in the mortar is unsafe, for the mortar is then structurally weak and crumbly, and this likewise is checked by a plasticity determination. In that test the force registered on the machine should be not less than 10, for a lower force indicates an extremely harsh working mortar, not satisfactory to handle. However, too much lime in a mortar means increased shrinkage, which likewise means trouble, and it is thought that 15 per cent shrinkage by volume is about the safe limit. A mortar composed of 15 parts by weight of hydrate and 85 parts of sand gives very good results in the laboratory, regardless of the type of hydrate used. This mortar corresponds roughly to a field mix of 1:13¼, using moist sand. When quicklime is used, slightly less lime is required. Although the final results have not yet been determined, the indications are that much the same relation holds in the field proportions as exists in the plant between quicklime and hydrate production. This of course is not the chemical relation of 56 to 74, which makes no allowance for loss or commercial discrepancies, but the fact remains that there is a difference.

"The results of the work on acoustics are also encouraging. The fellowship work has been completed, and the final report on this work is promised early in June. From the preliminary data which we have seen, this piece of research should prove of great interest and value to the lime industry.

"This year the report of the lime committee of the Building Officials Conference is still more complete than the one issued last year. It presents in compact for a full set of stucco and plaster specifications, in addition to the regulations as to mortar and hydrated lime in concrete. This organization holds a high position in municipal circles and the reports of the various committees bear considerable weight in the preparation of new codes and in the revision of existing ones. The lime committee has been continued, for we hope that before long a report on the lime block may be presented to still further increase the interest in lime.

Mr. C. P. Hoover, chemist, Water Purification Plant, Columbus, Ohio, addressed the convention on Friday morning on, "Advantages of Lime in Water Purification." Mr. Hoover discussed the impurities that cause

most of the troubles due to the use of hard water and their removal by the use of hydrated lime and sodium carbonate. The operation consists of removing a very objectionable salt and replacing it with one less objectionable or with water. Sulphuric acid plus hydrated lime gives calcium sulphate and two parts of water. water. The calcium sulphate is very objectionable and is removed with soda ash. Calcium sulphate plus soda ash gives calcium carbonate insoluble and sodium sulphate soluble. The bicarbonates are changed to the insoluble carbonates by the use of hydrated lime. Magnesium carbonate plus hydrated lime gives magnesium carbonate (insoluble), calcium carbonate (insoluble), and two parts of water. Iron, aluminum and magnesium combine with hydrated lime and are removed. To state briefly the facts as explained by Mr. Hoover, hydrated lime will remove all the carbon dioxide gas, all the acidity, iron, aluminum and magnesium and the calcium present as bicarbonate. The calcium compounds, formed or left as in the removal of sulphuric acid, are removed by soda ash. There are a number of other chemicals that may be used instead of hydrated lime; but hydrated lime is cheaper, just as good in most cases, and with soda ash will remove the total hardness of water thus leaving a soft water free from bacteria, clear, colorless and with a good taste.

Mr. Provost Hubbard, chemical engineer, The Asphalt Association, presented a paper on, "Lime in Asphalt." This paper dealt with the laboratory investigations made in connection with the use of hydrated lime as a mineral filler in asphalt pavements. Experiments on actual roads will be made and then something more definite will be known. At the present time limestone dust and Portland cement are being used. The mineral filler in an asphalt pavement is an important factor in the life of the pavement. The mineral filler is used in the wearing coarse and constitutes 15 per cent by weight of the wearing coarse mixture. This is about 15 pounds per square yard of asphalt pavement as a possible market for lime of nearly a million tons at the maximum based on the figures of last year and the assumption that only hydrated lime was used as mineral filler. Mr. Hubbard was very optimistic over the advantages of hydrated lime.

Mr. G. B. Arthur, Central Division Manager, N. L. A., in his report mentioned some very interesting work which is being conducted by his men. The possibilities of lime in oil refining was probably the most outstanding feature. At the time of the convention definite results along several lines were not ready for announcement.

Another interesting action of the convention was the adoption of a resolution recommending the appointment of a committee to present the facts on the lime industry in relation to freight rates since the Interstate Commerce Commission has announced that it will make an investigation of the rate structure. Such a committee was appointed by Mr. Wood.

This matter of freight rates was brought to the attention of the convention by Mr. Lowell Palmer at the suggestion of the Eastern District Lime Traffic Association. Early in January, 1924, Representative Hoch of Kansas offered a resolution to Congress embodying the theory that the present rate structure was unfair and that it should be corrected. Senator Smith, Chairman of the Senate Interstate Commerce Commission, introduced a resolution designed to bring lower freight rates on agricultural products.

Later the Hoch resolution with an addenda to the effect that the Interstate Commerce Commission give particular consideration to agriculture was substituted for the Smith Resolution and the result is known as the Hoch-Smith Resolution (Senate Joint Resolution No. 107).

Secretary of Commerce Hoover, came out very strongly as an advocate of that theory. The president's agricultural committee indorsed it. It was passed by Congress and approved by the President on January 30, 1925, becoming a law as of that date.

On the 12th day of March, 1925, the Interstate Commerce Commission issued an order under Docket, No. 17000, instituting an investigation of the entire rate structure of the United States, making all common carrier subject to its jurisdiction respondents, and mailing a copy to each of the governors of the several states.

Another action of interest was the

creation of an associate membership open to manufacturers of equipment of value to the lime industry. Mr. R. C. Towles attended the convention of the National Crushed Stone Association at Cincinnati in January and was impressed with the manufacturers' exhibit. He suggested that the lime association offer the equipment manufacturer similar privileges in connection with the annual lime conventions. A committee on organization approved the plan at this convention, and it is hoped that definite plans will be in effect before the next convention.

The convention elected Mr. Charles Warner, of Wilmington, Delaware, President, and Mr. J. J. Urschel of the Woodville Lime Products Company, Toledo, Ohio, Vice President. The National Lime Association is to be congratulated on its selection of its officers. Mr. Warner has served twice before as president of this association, and this experience, coupled with great ability as a leader and organizer, will prove of great value to the association. Mr. Urschel is an ideal associate, and his influence in the Ohio district will be a great help to Mr. Warner. The lime industry can look for a vigorous prosecution of its two major research problems, namely: the lime plaster investigations, and the lime building block investigation. The next year will prove the test of Mr. Warner's ability. With lime manufacturers increasing the capacity of the plants, new operations getting under way, etc., there is great need for a close association directed by a firm hand to uphold the quality and standards of the lime industry.

The Seventh Annual Convention of Lime Manufacturers adjourned at noon Friday, May 29th, and the newly elected Board of Directors went immediately into an executive session.

## The Fogarty Digging Bucket

A new bulletin issued by the McMyler-Interstate Company of Cleveland, Ohio, **Bulletin No. 71,** describes the Fogarty Digging Bucket. This bucket is described as having a particular field in that it is adapted for the hardest kind of digging, reaching and digging material "that cannot be handled by any other excavating tool."

The bucket does not depend on its own weight to sink it into the bite. The entire line pull of the crane, plus the weight of the operating arm, plus the weight of the bucket forces the Fogarty into the material. It is said that it cannot ride over even the hardest material. If the power is there to close it, the bucket must dig.

The operating arm which holds the bucket into the bite is built up of 10x10-in. channels. On the end of this operating arm is a cast steel gooseneck which supports the swivel head of the bucket. A steel yoke fastened to the goose-neck is the connection to which the hoist line is made. The bucket is constructed of high carbon steel and is built to with stand the hardest kind of service. Above the bucket and below the gooseneck on the operating arm is a swivel head which allows the bucket to turn when hanging free, but which locks rigidly when the bucket is in contact with the bite. In any position, the action of the Fogarty is simple and positive.

## New Ingersoll Rand Rivet Set

Ingersoll-Rand Company, 11 Broadway, New York, has now produced a rivet set for pneumatic hammers which last longer than three, four or even more ordinary sets. Users are finding it the most economical set they can buy because of the great increase in rivets driven per set and the avoiding of delays and losses of time due to breakage. This new set is call the "Jackset".

It is made of a high quality alloy steel which will stand a much greater degree of heat from hot rivets, without the temper becoming drawn. It is specially forged and then heat treated by a new process. This new set is the result of years of experience in building sets and of hundreds of tests on different steel and heat treatments, made in the effort to produce a tool better able to withstand the stresses of riveting service than the ordinary carbon steel rivet set.

### L. B. Foster Company Moves

Announcement is made that the general offices of the L. B. Foster Co., of Pittsburgh have been moved to their warehouse yards at Carnegie. A mailing office will be maintained at their former headquarters in the Park Building, Pittsburgh, where the president,. L B. Foster, will be located, all other offices having been moved to Carnegie.

# Serving Seventeen Different Outlets For Limestone Without Burning

## The Pacific Limestone Products Company Serves Broad Market Intensive Sales Promotion Quadruples Business in Two Years

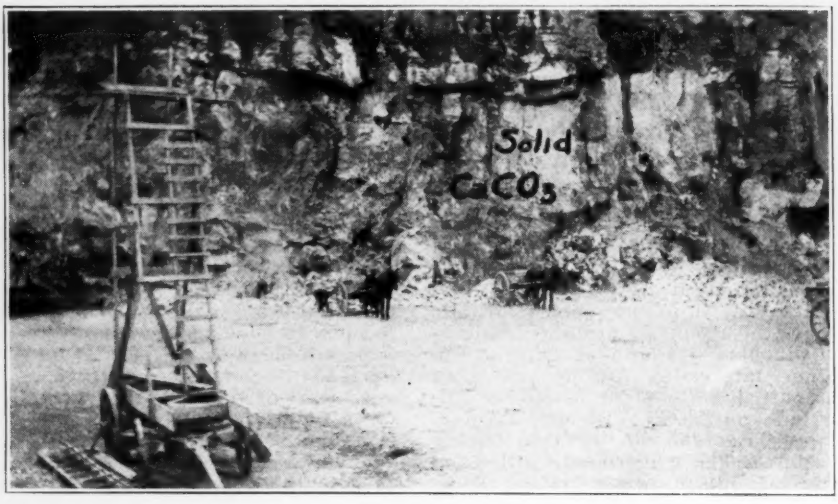
PACIFIC Limestone Products Company is a young concern being only two years old. This company bought out a firm which had been in business for over twelve years. Within the period of two years the Pacific Limestone Company quadrupled its annual sales. Another interesting fact is that they prepare limestone for seventeen different purposes without burning. These uses include terrazzo, stucco dash, chicken grit, roofing grit, commercial fillers, glass sand, motor sand cattle lime, poultry lime, fertilizer, concrete brick, roads, filler, etc. Preparing their product for these many uses has made it possible to increase the sales.

The plant and quarry of the Pacific Limestone Company consisting of 14½ acres is located within the corporate limits of the city of Santa Cruz, California, which is 84 miles south of San Francisco. The quarry is a limestone rock, medium hard with very fine to very coarse crystals. The rock is shattered and broken in large masses and is bluish white in color. The average face is 52 feet high with an overburden of from 2 to 8 feet of soil and red clay. The overburden is removed by shooting with black powder to the floor of the quarry, or else it is trapped in a 10-yard bin chute. If the overburden is shot to the quarry floor, it is picked up by a Haiss loader and loaded into wagons or trucks. A good deal of this overburden is sold for fill material. All that in not sold is hauled to a waste dump.

Rock is blasted down with 10 to 14 foot toe holes averaging 8 to 10 feet from the face with 40 per cent L. F. Extra Giant ⅞ x 8 dynamite. Due to the many vertical seams a large amount of the rock is broken down without drilling. Air from a 6 x 7 single stage Sullivan compressor furnishes power for a Sullivan "Junior" rotary jack hammer. Pieces over 24 inches are plug shot. All rock is broken with 16-pound rock hammers to sizes less than 6 inches.

Because of mixed impurities of magnesium and silica all rock is hand picked for its color, crystals and impurities. The piles of 6-inch

View of the Main Mill Building.




View of One Section of the Quarry.

rock is hauled to a number 4 Austin gyratory crusher in 1½-yard one-horse dump carts or in one-ton Ford trucks. This crusher is about 500 feet from the present quarry face. Three men are used to fill the carts, and there is a driver for every two carts. While the driver is hauling one cart to the crusher, the other cart is being filled.

The Austin crusher reduces the stone to 2½ inches or smaller. This stone is then elevated by a bucket conveyor a distance of 50 feet to three gravity screens. The bucket elevator has 9 x 12 inch buckets spaced 12 inch centers. The screens separate out ¼, ⅛, and from ⅛ to 30 mesh sizes. The mesh, if limestone is being crushed, drops into a bin directly below the screens and is sold as fertilizer. The ¼ and ⅛ inch sizes drop to bins below the screens and in front of a number 2 Williams hammer mill, or if desired, directly into another elevator that carries them to the grit screens. Stone larger than ¼ inch goes to a storage bin. Stone is drawn from this storage bin and conveyed horizontally 20 feet to a 30-inch by 14 feet revolving screen. This screen has its cloth in four sections, and separation are made as the trade de-

Left Half of a Panoramic View of Plant.

Another View of the Quarry.

mands. Flux stone is made in two sizes from ½ to 1½ inches and from 1½ to 2½ inches. The oversize from this screen drops to a number 2 Eureka jaw crusher. The discharge from this crusher is elevated 15 feet to a 30-inch by 6 feet revolving screen. This screen removes the dust and smaller sized crushed rock for special demands.

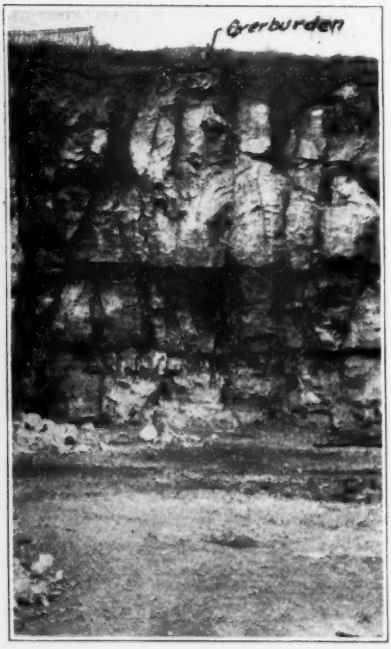
The discharge from the Williams mill is elevated 45 feet to a double cloth 30 inches by 10 feet revolving screen. This screen separates out four sizes. The tailings fall through a chute to a storage bin for recrushing. Each size is separated out from the screen drops to separate storage bins. The separation from the outer screen drops to a number 9 Rotex screen. The oversize from the Rotex screen passes to a storage bin directly over a number 2 Williams pulverizing mill which grinds the material to fertilizer limestone. The discharge from this Williams mill is elevated 35 feet and passes over a gravity screen that separates out the oversize. The oversize is returned to the Williams mill. All fertilizer is ground to pass a 22 mesh. The grits are weighed by a

Right Half of the Panoramic View of Plant.

Howe automatic net bagger. Fertilizer is weighed on standard grain scales. All products are bagged in 100-pound lots.

The plant operates the entire year. Sixteen men constitute the average working force. These men are practically all Portuguese. Four men are employed in the mill and sacking department, four men handle all hauling, and the rest are used in the quarry. During rush periods this force has been increased to 36 men.

The market served is within a radius of 150 miles. San Francisco and Petaluma are the two big market centers although Portland to the North and Los Angeles to the South are active centers of trade. All products are sold under the trade name of Kalkar. The Pacific Limestone Products Company has done a great deal of sales promotion work on lime in agriculture. Attractive folders have been prepared setting forth the advantages of the various Kalkar products. Records of tests, statements of results, recommendations, opinions, etc., which would tend to increase sales are broadcast through pamphlets to a mailing list of all prospective users of Kalkar products within a radius of 150 miles.




Section of Quarry Showing Average Overburden.

The officers of the Pacific Limestone Company include F. W. Johnson, President; D. L. Martin, Vice President; W. C. Johnson, Secretary-Treasurer, and E. A. Frenzel, Sales Manager. The experience of this company illustrates what can be done with a small plant. The many special sizes bring prices that pay special profits. The layout is simple and so arranged that the special products can be produced without any difficulty. The question is, does it pay to produce special sizes when the market is limited and the plant capacity small? The Pacific Limestone Company has decided that it does.

## Zin-Ho Air Compressors

A new folder put out by the Mundie Mfg. Co., of Peru, Illinois, describes the ZIN-HO Portable and Semi-Portable Direct Connected Air Compressors made by that company.

This company has for years been building belt-driven Portable Air Compressors on which they have used The Gardner Governor Company's Compressors. Recently The Gardner Company has perfected and put on the market a line of High Speed Duplex Vertical Air Compressors particularly adapted to be driven, direct connected by gasoline engine or electric motor, which are incorporated the latest and most practical devices and improvements known. These Compressors The Mundie Company has tested out with very satisfactory results.

The Mundie Company is now offering to the trade two sizes of these Portable Air Compressors, one with capacity of 118 cu. ft. of air per minute, piston displacement, and one of 160 cu. ft. of air per minute. The engines of both have a reserve power of 25% over the actual power necessary. The radiator has a core of ample height and thickness, incased in a rugged cast iron frame, that also has reserve of 25% over the actual power necessary to cool the engine and compressor. All the bearings of the Air Compressor are lubricated by a plunger type oil pump that is automatic, positive and dependable in operation. Cylinders and pistons are protected from dust by an air strainer which thoroughly filters the air of all dust particles.

# Blasting Practice in Quarry And Open Pit Mining

Written Expressly for Pit and Quarry, By R. N. Van Winkle*

This is the first of a series of six articles on this subject which is of concern to practically every nonmetallic producer. These articles will appear in consecutive issues of Pit and Quarry. Readers are invited to correspond with Mr. Van Winkle in relation to these articles or to blasting problems in general. The editor of Pit and Quarry will be pleased to receive comments or data on this subject from readers whose experience and knowledge will be of value in the study of blasting practice.—Editor.

FROM experience as a quarry and open pit mine operator and from added experience gained in consulting work along kindred lines, the writer has found that no condensed data is available covering blasting and explosive handling applicable to the quarry and open pit mining industry. Believing that the industry would welcome such data we have attempted with the assistance of several of the largest explosive manufacturers and the United States Bureau of Mines to compile or assemble such data. The writer is greatly indebted to his friends and to the United States Bureau of Mines, the E. I. DuPont de Ne Mours & Company, Hercules Powder Company, The Ensign-Bickford Company, Atlas Powder Company, Trojan Powder Company, and Illinois Powder Manufacturing Company for information and assistance which makes the compiling of this data possible.

There was a time when little or no attention was paid to the question of explosives in open pit and quarry operations. This was due primarily to the fact that little or no scientific data was available and that high explosives were cheap. Blasting today, however, is a highly scientific operation and should rightfully be if the greatest good is to be derived from this second most expensive operation in quarry and open pit mining. Blasting is second only to the item of labor. Successful operators are today devoting serious consideration and study to explosive matters, and are hiring competent and unbiased engineers for the handling of this operation, which costs quarry and open pit owners millions of dollars a year.

R. N. Van Winkle.

There is no magic or sleight of hand about the handling or use of commercial high explosives. It is doubtless true that any person of mature age and average intelligence can blast or shoot with dynamite or other high explosives. The question is with what degree of safety, efficiency and economy, which are the three fundamentals of all blasting operations, can it be done. High explosives are similar to all other powers placed in inexpert hands, a danger in human affairs. The manufacturers of explosives have not spared time or expense in trying to give the user the safest and most efficient explosives at a reasonable price, but the user is quite prone to turn over the handling and use of these materials to some "natural born" shooter or "natural born" powder man. Speaking from experience we know that competent

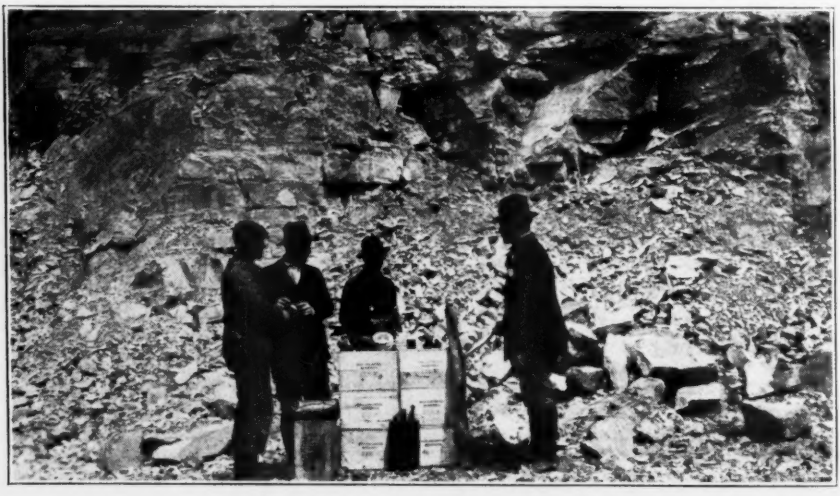
*Consulting Engineer, Cedar Rapids, Iowa.

shooters or powder men are made, not born; and if high explosives are to be used with any degree of safety, efficiency and economy, education along these lines is necessary. Several mining companies have special courses whereby they teach the fundamentals of the handling and use of explosives, and it would be hard to over-estimate the advantages gained by such companies from this practice. This teaching can be gauged according to the size of the operation or organization, and if there is no one competent to talk safety, efficiency and economy in the vernacular of the worker, it will pay to procure someone. It is a safe estimate to say that approximately 30 per cent of the high explosives used in open pit mining and quarry operations are absolutely wasted, due primarily to lack of forethought and lack of attention to the prime importance of blasting operations.

It is to be regretted that no hard or fast rule can be laid down for the economical and efficient use of high explosives, although it has been learned through research and experience that many old time methods and practices in the handling and use of explosives for commercial purposes should be thrown out. While the fundamental principles involved in the successful use of high explosives are similar, although not alike in detail, to underground mining, open pit mining and quarrying, it is questionable whether you will find conditions the same in any two operations. To understand scientific blasting and the principles involved, one must familiarize himself with the terms used and their meanings. If the writer can make some suggestions, or clear up some points in blasting or drilling problems in the following, his purpose will be accomplished.

**Action of Explosives**

Every user of explosives should know in a general way what takes place when commercial explosives, which are solids or liquids, are fired or exploded. Explosives are a chemical combination of stable ingredients which when detonated will rapidly generate gases, previously held in suspension. The reaction that occurs when explosives are detonated or fired is the very rapid decomposition of this chemical combination into largely or entirely gas having many, many times greater volume than the volume of the original charge of explosive itself. This increase in volume exerts both a blow and pressure, better defined as a propulsive and disruptive action, on that which tries to confine it. The forces that are so liberated exert pressure equally in all directions regardless of beliefs to the contrary, and moreover these forces naturally follow the lines of least resistance. From the foregoing it is evident why tamping and stemming are so essential; to confine the explosive action and keep the gases generated from escaping. If these gases can leak



Instruction in Safety, Efficiency and Economy.

out and escape, only noise and no destructive or useful work will be accomplished by the explosive charge. Practically all explosives act in a similar manner as outlined above; therefore, irrespective of what explosive is used, it is almost impossible to take too much care and pains in loading and tamping operations. The change of the chemical composition making up high explosive into gases is accomplished by heat or severe shock, and when explosives are detonated or fired, the pressure of the gas so generated, if properly confined, is further expanded by the heat of combustion of the gases. The result is that the material confining it is broken, ruptured and fragmented. Both heat and fumes are results of an explosion of dynamite, and while they as a general rule do not bother in open pit operations, this element of heat is to be reckoned with in the chambering or springing of drill or bore holes as will be seen later. Fumes from the explosion of certain dynamites, and not only fumes, but the mere handling of certain dynamites, are conducive of severe headaches known as "dynamite headaches". These headaches are quite common and while not serious or dangerous, cannot, as far as the writer knows, be cured by any remedy except sleep and rest. It is claimed by some that by the constant handling of dynamite and exposure to these fumes a man becomes immune to "dynamite headache".

**Kinds of Explosives**

There are almost as many brands, makes, strengths and sizes of explosives manufactured as there are places for them to be used, and no doubt they are necessary or explosive manufacturers would not make them. All explosives have certain disruptive or shattering forces and at the same time propulsive or heaving tendencies. The selection of the explosive is dependent on the work to be done, as is also the quantity and size of cartridges. Straight or nitroglycerin dynamite is more economical for general use in blasting operations, if conditions and character of work are such as to permit its use, being the best buy for the money. Straight nitro-glycerin dynamite is quick in action and has great percussive force and is therefore not always as adaptable as may be ammonias, starch, specials, bulky or high cartridge county dynamites or black powder, which are not so quick in action and tend to have more of a propulsive or heaving and less shattering action. Black powder has even more of a spreading effect than dynamite, but it lacks the shattering or disruptive effect contained in dynamite. There is no explosive that is universally the best, and extravagant claims which are sometimes made that this or that particular explosive is a general blasting cost reducer should be taken with a grain of salt and an investigation made of its characteristics and the results obtained from its use in other places.

Reference is often made to velocity when talking of explosives, and while it is not contemplated to attempt to cover the matter thoroughly, a little information on the subject will be found of benefit. Velocity, or the rate of velocity, is the wave of detonation, or the rate of the wave of detonation, which is started through the explosive charge when dynamite is fired by the impulse or impelling force given by the explosion of a blasting cap or electric exploder. It is, as a rule, the maximum rate of detonation that is referred to as velocity and is expressed in feet per second. As the velocity of an explosive has a direct bearing upon its shattering qualifications, it is important to give consideration to the velocity of detonation in the selection of explosives, especially in quarrying and open pit operations. The following table shows the approximate velocities of some of the commercial explosives applicable to quarrying and open pit operations. While it is not claimed that the table is perfect, it give a good idea of the relative velocities of explosives listed. Velocities determined by different people may differ according to variation in methods employed in testing and formula used in making the explosive, but the table given will suffice to give relative velocities at least.

In making use of the table, Velocity or Detonation of Explosives in Feet per Second, it must be remembered that the selection of the detonator, confinement of the explosive charge, loading, tamping, density and strength of explosive have a marked effect upon the velocity. Ordinarily for given rated strengths, straight nitro-glycerin dynamites are the fastest, while next come the extras and

last the bulky, specials or high cartridge count explosives. Gelatins, when tested in the regular manner, show relatively low velocities, but under confinement, as will be seen from the table, assume high rates, higher even than straight nitro-glycerin dynamites in which the increase in velocity due to confinement is as a general thing comparatively small.

Do not be misled by claims that explosives and blasting accessories will not deteriorate. Dynamite will deteriorate with age, improper treatment and storage, and deterioration will be evidenced by its becoming soft, sometimes very mushy and by changing color to a brown or dark brown. Cases of old explosives will become stained, showing evidence of bleeding or leaky cartridges. Dynamite in such condition cannot be shipped and if used will invariably cause trouble by failing to explode, misfiring or burning and should, therefore, be destroyed.

**Selection of Explosives**

Each quarry presents its own particular problems as far as blasting operations are concerned. The things to be considered in determining the proper strengths, sizes and kinds of explosives to be employed depends on the nature of the material or ground to be shot, the direction of the strata, thickness of ledges, size of crusher, purpose for which the blasted stone is to be used, whether wet or dry work, and the system of drilling to be employed. The system of drilling employed has as much bearing on the selection of explosive to be used as any other one element; and while blasting operations cannot be rightfully termed secondary to drilling, the operations are so dependent on each other for adequate results that they should in reality be grouped under one operation, drilling and blasting. The explosive to be chosen depends, aside from the things enumerated above, on whether you require a quick acting concentrated, a slow acting heaving, or a bulky explosive. For secondary blasting operations bulky explosives of low strength or low grades are satisfactory, as all that is necessary is to break the material and not send it flying in all directions. While it is not the intention of the writer to get into a complicated discussion of the strengths or relative energy contained in different grades of dynamite, a short discussion of the subject may be timely. The erroneous idea that 40 per cent dynamite or 60 per cent dynamite is two or three times as strong respectively as 20 per cent dynamite should be corrected. For the purpose of comparison the United States Bureau of Mines has adopted as their standard or base, straight dynamite, being a mixture of 40 per cent nitro-glycerin, 44 per cent sodium nitrate, 15 per cent wooden pulp and 1 per cent calcium carbonate. As a rule all explosive strengths are rated in percentages against 40 per cent straight nitro-glycerin as the base or 100 per cent. As a guide the following table is given, the figures of which are fairly accurate with general practices and should serve as a useful guide for practical values of explosives.

Another table which might prove valuable is the following one which gives the requisite amount of dynamite of any strength to equal one cartridge of a given strength. For instance, one cartridge of 50 per cent, by reference to the table, is equal to 0.89 of a cartridge of 60 per cent, and 1.07 cartridge of 45 per cent, and 1.45 cartridge of 25 per cent, and so on.

As a rule regulating the transportation of explosives, railroads will accept for transportation high explosives containing more than 10 per cent nitro-gylcerin, (gelatin dynamite excepted), only when made in cartridges not exceeding 4 inches in diameter and 8 inches in length. Cartridges 5 inches in diameter and not over 8 inches in length may be shipped and will be accepted, provided each cartridge is completely enclosed in another paper shell, the complete cartridge being dipped in melted paraffin. It is always to be recommended that in shipping, storing or transporting commercial high explosives one familiarize himself with all rules, laws or local regulations governing same and be safe rather than sorry.

**Amount of Explosives to Use**

No hard or fast rule can be laid down for the amount of explosives to be used, as far too many factors govern this. The basis, however, that can be used in figuring the amounts of high explosive is to ascertain first by experience or a trial shot the number of tons of stone or ground that can be shot to the re-

Typical Analysis and Strength of Blasting Explosives

Percentages Rated Against 40 Percent Straight Nitro-glycerin

| | Nitro-glycerin | Combustible Material | Nitro Substitution | Potential Energy | Disruptive Effect | Propulsive Effect | $NaNO_3$ |
|---|---|---|---|---|---|---|---|
| Straight N.G. 30% | 30 | A.17 | | 93.1 | 84.1 | 96.8 | 52 |
| Straight N.G.40% | 40 | B.15 | | 100.00 | 100.0 | 100.0 | 44 |
| Straight N.G.50% | 50 | B.14 | | 111.0 | 109.2 | 107.4 | 35 |
| Straight N.G.60% | 60 | B.16 | | 104.0 | 119.8 | 114.9 | 23 |
| Low Freezing 40% | 30 | B.15 | 10 | | | | 44 |
| Low Freezing 60% | 45 | B.16 | 15 | 60.2 | 93.5 | 91.2 | 23 |
| Ammonia 40% | 22 | A.15 | | 101.8 | 67.9 | 99.1 | 42 |
| Gelatin 40% | 33 | A.13 | | 105.7 | 78.4 | 95.8 | 52 |
| Granulated Nitro Glycerin Powder | 5 | C.35 | | 67.6 | 21.6 | 53.3 | 60 |
| Black Powder | | | | 71.6 | 6.8 | 58.6 | 73 |

"A" Wood Pulp, Flour, Sulphur - "B" Wood Pulp only - "C" Sulphur, Coal, Resin - "Na $NO_3$" Sodium Nitrate

| One Cartridge | 60% | 50% | 45% | 40% | 35% | 30% | 25% | 20% | 15% |
|---|---|---|---|---|---|---|---|---|---|
| 60%.... | 1.00 | 1.12 | 1.20 | 1.28 | 1.38 | 1.50 | 1.63 | 1.80 | 2.08 |
| 50%.... | 0.89 | 1.00 | 1.07 | 1.14 | 1.23 | 1.34 | 1.45 | 1.60 | 1.85 |
| 45%.... | 0.83 | 0.93 | 1.00 | 1.07 | 1.15 | 1.25 | 1.36 | 1.50 | 1.73 |
| 40%.... | 0.78 | 0.87 | 0.94 | 1.00 | 1.08 | 1.17 | 1.27 | 1.40 | 1.59 |
| 35%.... | 0.72 | 0.81 | 0.87 | 0.93 | 1.00 | 1.09 | 1.18 | 1.30 | 1.50 |
| 30%.... | 0.67 | 0.75 | 0.80 | 0.85 | 0.92 | 1.00 | 1.09 | 1.20 | 1.38 |
| 25%.... | 0.61 | 0.69 | 0.74 | 0.78 | 0.85 | 0.92 | 1.00 | 1.10 | 1.27 |
| 20%.... | 0.55 | 0.62 | 0.67 | 0.71 | 0.77 | 0.83 | 0.90 | 1.00 | 1.15 |
| 15%.... | 0.48 | 0.54 | 0.58 | 0.61 | 0.66 | 0.72 | 0.78 | 0.86 | 1.00 |

Table showing number of cartridges of any given strength required to equal one cartridge of any other strength.

quired fragmentation per pound of explosive, or determine the amount of high explosives in pounds or fractions of a pound which will be required to fragmentate properly one ton of stone or ground. This information, which is a basic essential, can be gained only by experience and careful study and tabulation of each separate operation. If no experience data is available, it is good policy to begin by taking the judgment of a competent, unbiased and experienced engineer. As a rule from 4 to 6 tons of stone, where well drilling is used, is considered a good average for primary shooting per pound of explosive. This is for primary blasting or shooting. For secondary blasting, where the block hole methods are used, one pound of explosive should suffice for from 15 to 18 tons of stone, depending entirely on the success of the primary blast. Where mud capping is practiced, which practice is extremely wasteful and should not be tolerated except as an emergency measure, one pound of explosive will produce about 4 tons of stone in secondard shooting. It is well to keep in mind that the above figures are merely guides and that many conditions regulate the tons of stone that can be efficiently shot per pound of explosives. Under the heading, "How to Figure a Shot," which follows, more detailed information and tables will be given as to the amount of explosives necessary for any particular job.

**VELOCITY OF DETONATION OF EXPLOSIVES IN FEET PER SECOND**

| KIND | Velocity in feet per second for different strengths | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 5% | 10% | 15% | 20% | 25% | 30% | 35% | 40% | 60% | 75% |
| Low Powders, R. R. P. | 3.300 | | | | | | | | | |
| F. | | 6.600 | | | | | | | | |
| Straight Nitro-Glycerin | | | 9.500 | 9.800 | 11.000 | 13.500 | 15.400 | 17.400 | 21.000 | |
| Extras or Mixtures of Ammonium Nitrates and Nitro-Glycerin | | | | 9.200 | 9.500 | 10.000 | 12.500 | 13.400 | 17.400 | |
| Gelatin* | | | | | 12.500 | 14.000 | 16.700 | 18.000 | 21.300 | 21.500 |

*Figures on Gelatin are based on confinement.

An Excellent Picture of Moving Stone.

# Concerning Waste Heat Recovery From Rotary Lime Kilns

Written Expressly for Pit and Quarry, By Charles Longenecker

THIS is the second of a series of opinions to be published in Pit and Quarry concerning the application of waste heat systems to rotary lime kilns as a possibility for securing substantial savings.

We realize that such a possibility needs to be carefully investigated. In practically every case it is a question of plant layout. In comparison with the amount of fuel required there is little power needed for a lime plant. A waste heat system attached to a lime kiln will produce normally more steam than the plant could use. However, if a lime plant is so situated that it can utilize or sell the excess power from the kiln, the installation of a waste heat system could be made to pay for itself.

Readers are urged to submit their opinions on this problem. Material received will not be published without the author's approval or will be published anonymously if desired. It is our desire to bring to the attention of the lime manufacturer all the data possible on this interesting question.—Editor.

THE answer to the question as to the advisability of installing waste heat boilers on rotary lime kilns is to be found in the economy to be derived by such an installation. It is altogether a matter of balancing savings against expenditures. This makes it a problem for the individual plant. There are so many factors to be considered, any one of which may involve the success or failure of such an installation that no decision can be reached until each has been fully appraised. Each plant has different characteristics such as number of kilns in steady operation, amount of power required, cost of fuel, cost of purchased power, market for surplus power, etc., and all of the variables will have a bearing in reaching a decision. From an operating standpoint the heat available will be approximately as follows. Assume four pounds of lime burned per pound of coal. For one ton (2000 pounds) of lime 500 pounds of coal will be consumed. The amount of excess air in the waste gases when the stack is reached, let us assume, will be 50 per cent. This figure will vary and may run as high as 100 per cent in some plants. There would be approximately 15.40 pounds of waste gases, with 50 per cent excess air, passing out of the kiln, and this would carry with it on an average 2,303,500 B. T. U. per 500 pounds of coal. To this must be added the heat in the $CO_2$ driven from the stone. For every ton of lime burned approximately 1580 pounds of $CO_2$ gas will go into the waste gases. This 1580 pounds of $CO_2$ at 1200 degrees F will contain 496,800 B. T. U. The total heat in the waste gases then passing from this kiln at 1,200 degrees F. is 2,800,300 B. T. U. Assuming an efficiency of heat absorption of 65 per cent by the boiler there would be recovered 1,820,175 B. T. U. This is equivalent to 55 boiler horse power from and at 212 degrees F. Thus for every ton of lime produced there would be reclaimed by installing waste heat boilers fifty-five horse power. This is equivalent to 140 pounds of coal, of 13,000 B. T. U. per pound. These figures are an approximation but are sufficiently close to afford an idea of the saving which can be effected. With coal costing say $5.00 per ton, 140 pounds represents a saving, when used for steam generation of $\frac{140 \times 100 \times 65}{2{,}000} \times \$5.00 = 54$ cents. The 140 pounds of coal represents a saving from the kiln equal to 215 pounds burned at 65 per cent efficiency under a boiler.

To effect this reclamation of 55 H. P. a boiler must be installed and this will cost about $25.00 per horse power. For 55 H. P. the cost would be 55 x $25=$1,375. The $25.00 per horse power covers the cost of the boiler erected and bricked up. For steam generation, then, the cost of the boiler would be met by the burning of 2,564 tons of lime.

The foregoing briefly and simply illustrates the principal factors in balancing the saving against expenditure. There are other factors which

must be considered in arriving at a solution of the problem. The advisability of installing waste heat boilers depends among other factors on the type of plant under consideration. The particular plant may be in process of design. Here the problem would be whether to install waste heat boilers; stoker, pulverized coal or hand fired boilers; or whether to purchase power. If on the other hand the plant is already in operation, it is very probable that it would be a difficult matter to install waste heat boilers as the installation of these was usually not provided for in the layout of the older plants.

The first factor in every case is to know the amount of heat which will be available from the kilns for the generation of steam. This depends on the market for the lime and is frequently a very uncertain item.

Another feature is the price of fuel at the particular plant and the regularity of supply. This latter feature is today of little moment, but at times it assumes alarming proportions. With scarcity of fuel the waste heat boiler is a blessing. Naturally when fuel is high in cost any heat secured from the waste gases is most welcome. In a locality where fuel is consistently low in price, purchased power will in all probability be low and waste heat boilers lose their attractiveness. The business of the lime manufacturer is to make lime, and if he can delegate the making of power to another, he is relieved of a very considerable responsibility.

In plants not laid out for waste heat boilers there will in all likelihood be insufficient draft, from the stack, for both the kiln and an added boiler. This would mean the installation of an induced fan which would increase not only the first cost but the cost of the power to operate the fan. This fan may prove to be an advantage and it may not. When running it will assure a constant draft on the kiln; but if it fails to function, the kiln must stop.

The condition of the stone fed to the kiln will also influence the results obtained. Should the stone have a high content of surface moisture, the heating of the boiler would not be as satisfactory as when the stone is dry.

The aim in these comments has been to point out the variables rather than to analyze them. They cannot be analyzed unless they are fully known in degree, and the degree varies in practically every plant. The engineering must be carefully carried out so that not only is the boiler of the correct horse power, but also it must be of the proper type.

## New Incorporations

Midcontinent Portland Cement Co., Wilmington, Del., Capital, $11,000,000.

North Carolina Amiesite & Stone Co., Dover, Del., Capital, $6,200,000.

Eastern Oklahoma Amiesite Co., Muskogee, Okla., Capital, $100,000. Incorporators, W. E. Delehant, D. McInerney.

Western Amiesite Asphalt Co., Wilmington, Del., Capital, $12,100,000.

Colorado Fluorspar Co., New York, N. Y., Capital increased from $100,000 to $700,000.

Alatary Mica Co., New York, N. Y., mineral products; 250 shares at $100 each, 100 Common shares, no par value. Incorporators, A. T. Kraut, J. Dubi, E. H. Taussig.

Kanawha Cement Block Company, Charleston, W. Va., Capital $50,000. Incorporators, Anton Paff, Harry E. Penhale, John H. Linn, W. E. R. Byrne, T. F. Cook, all of Charleston.

Franco Sand and Gravel Co., Schenectady, N. Y., Capital, $10,000. Incorporators, J. N. Cohen, A. Franklin and Edward Cohen.

The Estill Sand & Gravel Co., Louisville, Ky., is increasing its Capital stock from $35,000 to $110,000.

The Linthicum Stone Corp., a million-dollar industry, has bought the plant of the Stuart R. Carr Foundry in Baltimore and will operate with 75 to 100 men. Raw material will be secured from the Beaver Dam Quarries at Cockeysville. Native granite, marbles and limestones will be produced. Officers are: Frank H. Linthicum, president and general manager; H. W. Webb-Peploe, vice-president and general sales manager; H. A. Yerkes, vice-president, treasurer and secretary.

The Stockton Rock and Gravel Company of Sacramento, Calif., Capital, $200,000. To operate rock crushing plants in the San Joaquin Valley. Directors: R. Goold, Kathryne Goold and P. W. Thomas, all of Stockton.

# I've used it like a Steam Shovel and haven't stopped it yet!

The man who said that, operates a quarry, builds roads, has a sand and gravel bank— and uses the

## Haiss Creeper Loader

on every loading job he comes up against. It's brutal use for a Loader but the machine is right there. We saw it last digging a new road into the gravel pit— making a cut through a 12 - 15 foot bank. Before that it was loading the fine stone dust spoil that had accumulated in years of crusher plant operation— hard, cemented together, a tough job for any machine. All that is typical Haiss Loader service. You hear it from all over— "You ought to see my Haiss machine dig." And operators have finally gotten wise to the fact that a Haiss Loader is not merely a stockpile machine, but a flexible piece of equipment.

**The Ideal Machine for the Small Sand and Gravel Operator**

***It's so good because it is different.***

**Haiss Feeding Propellers**
**Slow-Speed Crowding Drive**
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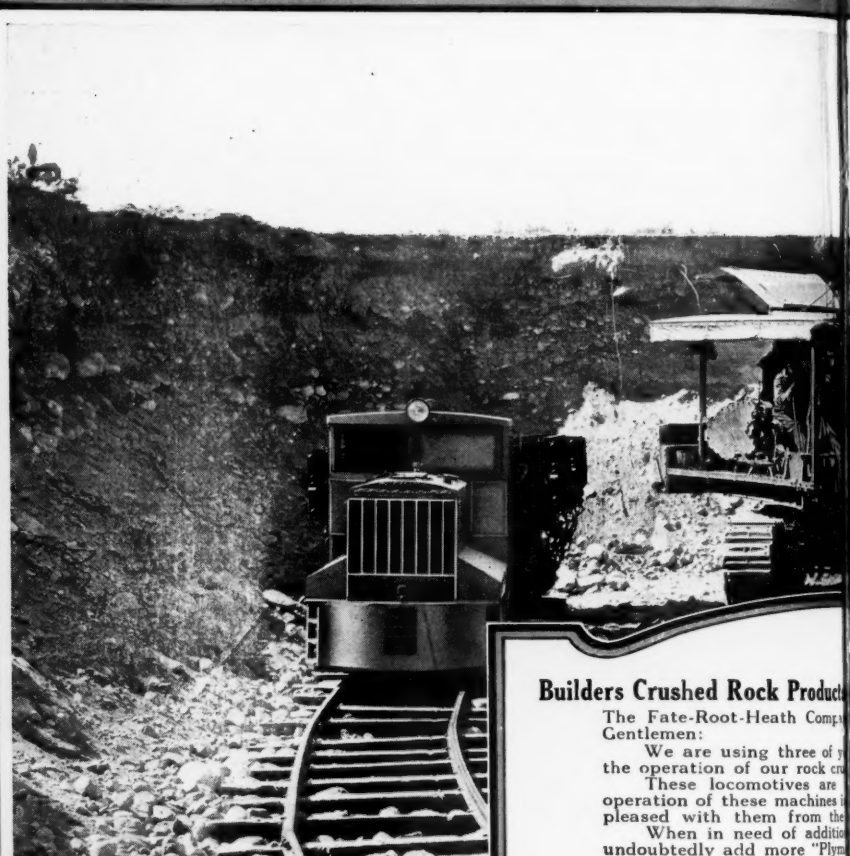

**Builders Crushed Rock Product[illegible]., Los**

The Fate-Root-Heath Comp[illegible] Plym
Gentlemen:

We are using three of y[illegible] 8-ton
the operation of our rock cr[illegible]ng plan
These locomotives are [illegible]ng ex
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pleased with them from the [illegible]and-poi
When in need of additio[illegible] equipm
undoubtedly add more "Plym[illegible]s."

BUILDERS CRU[illegible]ED RO
G. W. K

*More Plymouth Gasoline Locomot[illegible] are us*
*other make[illegible]mbine*

**THE FATE-ROOT-HEATH CO[illegible]**

PLYM[illegible]
Gasoline [illegible]

Product Co., Los Angeles, May 8, 1925
Company Plymouth, Ohio.

Gentlemen: Three of your 8-ton Plymouth locomotives in rock crushing plant near Azusa, California. These are giving excellent satisfaction. The machines are very simple. We are particularly from the standpoint of economy. If additional equipment of this kind we will re "Plymouths."

Yours very truly,
RS CRUSHED ROCK PRODUCTS CO.
C. W. Kelsey, President

*Locomotives are used in California than all other makes combined.*

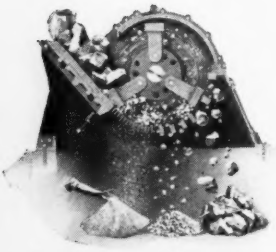
ATH CO PLYMOUTH, OHIO

PLYMOUTH
locomotives

Showing size of rock reduced to ¾ inch with Mammoth Crusher.

# "Mammoth Crusher takes rock as large as 2½ yd. Dipper will handle— Reduces to ¾ inch"

***San Antonio Pt. Cement Co.***
***San Antonio, Texas***



Cross sectional view of Williams Hammer Crusher showing how any size rock can be made by using larger or smaller grates and by raising or lowering the patented adjustable front end.

48 inch cubes of limestone—any size rock their 2½ yd. dipper can pick up is reduced to ¾ inch in one reduction by the Williams Mammoth Crusher at the San Antonio Portland Cement Co. plant. Here again one Williams Crusher is doing work which would require 2 or 3 crushers of any other type. First cost is 50 per cent to 75 per cent less. Fewer crushing operations and no handling expense between crushers obviously means lower crushing costs.

Smaller and less expensive buildings and foundations are other advantages. Williams Crushers will handle equally large rock and reduce for macadam and kiln stone with no more fines than jaw or gyratory crushers. Describe your work and let us send data.

## Williams Patent Crusher & Pulv. Co.

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**PATENT CRUSHERS GRINDERS•SHREDDERS**

# Building a Sand and Gravel Business As a Family Institution

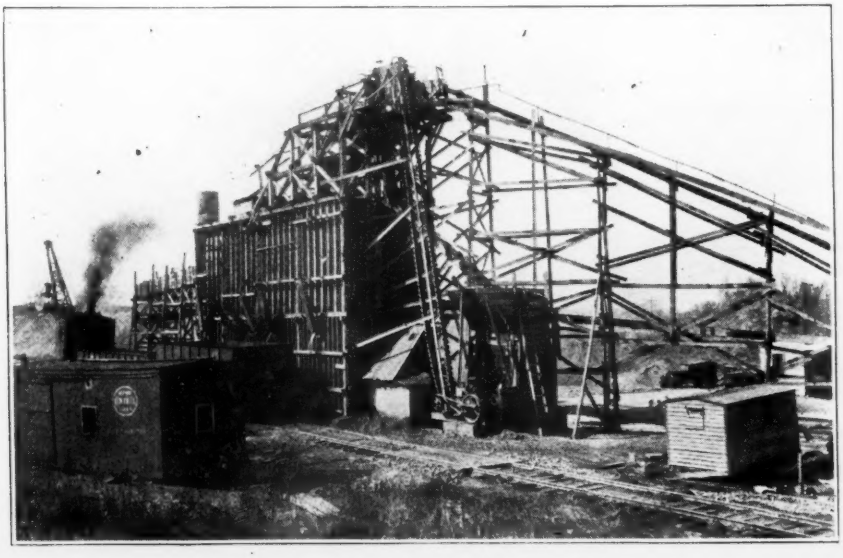
## A. E. Sheltraw Installs Modern Washing and Screening Plant Third Generation Now Interested in Business Started in 1886

THE increased demand for washed and screened gravel and sand in the vicinity of Lansing, Michigan, led A. E. Sheltraw to install a modern washing and screening plant in his pit which is located on the so-called "Hog's back" about three miles from the city of Lansing. Although this plant cannot be placed among the larger ones, it is efficient and modern and has many interesting features.

The gravel which is of glacial origin, runs about 20 feet below the water, and the bank extends about 30 or 35 feet in height. The material, which runs about 30 per cent gravel, is of good quality and generally speaking does not run much to stone over 4 or 5 inches in diameter. It thus affords good pumping material. There is not much overburden, and what there is, is stripped by teams and scrapers.

The material is pumped by an 8-inch Amsco centrifugal pump, located on a barrel-floated barge. The pump is directly connected to a 150 H. P. slip ring motor. A four inch pump, driven by a 10 H. P. General Electric Motor, supplies water for priming and for washing down the bank. A Domestic Hoist, electrically driven, supplied by the American Manufacturing and Engineering Company of Kalamazoo, is employed for raising the suction line to remove large stone from the nozzle. Power at 440 volts 60 cycles is supplied by the Consumers Power Company.

The material, which passes through about four hundred feet of discharge pipe to the top of the plant which is about fifty feet high, goes from the receiving hopper through a set of Gilbert screens. The first screen has perforations of 2¼ inches and acts as a scalping screen. The rejections from this screen go down a chute to a bin which is located just above the crusher, which is located on the ground. This bin, which holds about forty yards, is emptied whenever it fills up, the material feeding directly into the crusher. From there it is elevated to the receiving hopper and again goes into the first screen. The Reliance jaw crusher and elevator



View of Washing and Screening Plant.

A View Showing Entire Plant of A. E. Sheltraw.

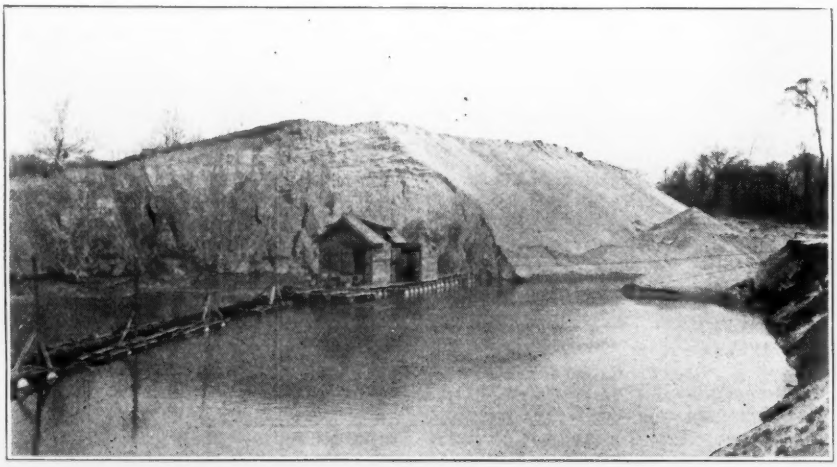
were furnished by the Universial Road Machinery Company of Kingston, New York. The crusher and elevator are operated by a 25 H. P. General Electric Motor.

The material passed through the first screen goes into the second which has one inch perforations. The material rejected by that screen goes into the first gravel bin which holds about 150 yards, as do the other bins. That which goes through the second screen passes into the third screen which has $\frac{5}{16}$ inch perforations. The rejections from this last screen comprise the material for the second gravel bin. The material which passes through the $\frac{5}{16}$ inch screen goes into the sand flume. This is about 65 feet long, three feet wide and four feet deep. Baffles are placed in the front part of the flume to form eddies and precipitate the small pebbles and coarser sand, which is stored in the first or concrete sand bin. A little farther on in the flume, the finer sand used for finishing and for block making is drawn off and saved in the second or finer sand bin. As the flume continues, a finer grade of sand is obtained, and at the end, a grade of plastering and asphalt sand is obtained. This is not placed in a bin but piles up under the flume and is reclaimed by a crane. The refuse water, after all the sand has been removed, goes through a trough back to the pond. The operation of the sand settling flume is simple and effective. The sand precipitates, and the dirty water and loam rise to the top and are carried away.

A set of chutes from each of the four bins is located on either side of the plant, trucks being loaded on one side, and railroad cars on the other. The bin gates and chutes were furnished by the Smith Engineering Works of Milwaukee, Wisconsin. An Orton and Steinbrenner locomotive crane is used for switching cars and for reloading from stock piles, and also for bank run loading.

Mr. Sheltraw is a pioneer in the gravel business in this locality, having been in the industry for many years. His father-in-law, Peter Malcolm, started loading gravel from his Kilwinning Pit at Mason, Michigan, in 1886, and Mr. Sheltraw was associated with him until the death of Mr. Malcolm some twenty years ago. Since that time he has been actively engaged in the gravel business on his own account and since 1921 Mr. Sheltraw's son has been associated with him.

The plant is served by the Michigan Central Railroad, and shipments are made to Bay City, Saginaw, and intermediate points as well as to the city of Lansing and vicinity. A large amount of the material used for constructing the paved highway from Lansing to Holt was obtained from this plant last year. The capacity of the plant is about 250 yards per ten hour day, and a crew of six or seven men is employed.



View of Deposit of A. E. Sheltraw Plant.

# Portland Cement Output in April, 1925

The following tables prepared under the direction of Ernest F. Burchard, of the Department of the Interior, Geological Survey, are based mainly on the reports of producers of Portland cement. The April, 1925, totals include estimates for one plant. April production and shipments were the highest for that month in any year; stocks decreased slightly but were higher than ever before except at the end of March, and are equivalent to the consumption for nearly 1.4 months at the present rate.

**Production, shipments, and stocks of finished Portland cement, by districts, in April, 1924 and 1925, and stocks in March, 1925, in barrels.**

| Commercial District | Production April | | Shipments April | | Stocks at end of April | | Stocks at end of March |
|---|---|---|---|---|---|---|---|
| | 1924 | 1925 | 1924 | 1925 | 1924 | 1925 | 1925a |
| Eastern Pa. N. J. & Md... | 3,024,000 | 3,337,000 | 3,361,000 | 3,808,000 | 4,392,000 | 4,571,000 | 5,042,000 |
| New York..... | 656,000 | 731,000 | 613,000 | 771,000 | 1,301,000 | 1,232,000 | 1,272,000 |
| Ohio, Western Pa. & W. Va.. | 981,000 | 1,275,000 | 999,000 | 1,276,000 | 1,918,000 | 2,017,000 | 2,017,000 |
| Michigan..... | 615,000 | 868,000 | 679,000 | 865,000 | 888,000 | 1,326,000 | 1,323,000 |
| Wis. b, Ill., Ind. & Ky.... | 1,723,000 | 1,957,000 | 1,973,000 | 2,140,000 | 2,701,000 | 3,555,000 | 3,739,000 |
| Va., Tenn., Ala. & Ga.... | 886,000 | 1,111,000 | 933,000 | 1,134,000 | 755,000 | 682,000 | 706,000 |
| Eastern Mo., Ia., Minn. & S. Dak. c..... | 982,000 | 1,347,000 | 1,251,000 | 1,316,000 | 2,519,000 | 3,303,000 | 3,271,000 |
| Western Mo., Neb., Kan. & Okla..... | 895,000 | 1,063,000 | 1,036,000 | 1,029,000 | 1,124,000 | 1,596,000 | 1,562,000 |
| Texas..... | 404,000 | 405,000 | 463,000 | 451,000 | 337,000 | 295,000 | 342,000 |
| Colo. & Utah.. | 204,000 | 224,000 | 219,000 | 217,000 | 196,000 | 312,000 | 306,000 |
| Calif..... | 1,017,000 | 1,096,000 | 970,000 | 1,090,000 | 418,000 | 521,000 | 514,000 |
| Ore., Wash., & Mont..... | 339,000 | 393,000 | 274,000 | 297,000 | 610,000 | 472,000 | 375,000 |
| | 11,726,000 | 13,807,000 | 12,771,000 | 14,394,000 | 17,159,000 | 19,882,000 | 20,469,000 |

a Revised. b Began producing and shipping June, 1924. c Began producing December, 1924, and shipping January, 1925.

Stocks of clinker, or unground cement, at the mills at the end of April, 1925 amounted to about 9,731,000 barrels (revised) at the beginning of the month.

**Production, shipments, and stocks of finished Portland cement, by months, in 1924 and 1925, in barrels.**

| Month | Production | | Shipments | | Stocks at end of month | |
|---|---|---|---|---|---|---|
| | 1924 | 1925 | 1924 | 1925 | 1924 | 1925 |
| January..... | 8,788,000 | 8,856,000 | 5,210,000 | 5,162,000 | 14,155,000 | 17,656,000 |
| February..... | 8,588,000 | 8,255,000 | 5,933,000 | 6,015,000 | 16,815,000 | 19,689,000 |
| March..... | 10,370,000 | 11,034,000 | 8,995,000 | 10,279,000 | 18,189,000 | a20,469,000 |
| 1st quarter..... | 27,746,000 | 28,145,000 | 20,138,000 | 21,456,000 | ..... | ..... |
| April..... | 11,726,000 | 13,807,000 | 12,771,000 | 14,394,000 | 17,159,000 | 19,882,000 |
| May..... | 13,777,000 | ..... | 14,551,000 | ..... | 16,403,000 | ..... |
| June..... | 13,538,000 | ..... | 15,036,000 | ..... | 14,903,000 | ..... |
| 2nd quarter..... | 39,041,000 | ..... | 42,358,000 | ..... | ..... | ..... |
| July..... | 14,029,000 | ..... | 16,614,000 | ..... | 12,319,000 | ..... |
| August..... | 15,128,000 | ..... | 16,855,000 | ..... | 10,666,000 | ..... |
| September..... | 14,519,000 | ..... | 16,827,000 | ..... | 8,404,000 | ..... |
| 3rd quarter..... | 43,676,000 | ..... | 50,296,000 | ..... | ..... | ..... |
| October..... | 14,820,000 | ..... | 17,160,000 | ..... | 6,073,000 | ..... |
| November..... | 13,141,000 | ..... | 10,289,000 | ..... | 8,928,000 | ..... |
| December..... | 10,435,000 | ..... | 5,506,000 | ..... | 13,913,000 | ..... |
| 4th quarter..... | 38,396,000 | ..... | 32,955,000 | ..... | ..... | ..... |
| | 148,859,000 | ..... | 145,747,000 | ..... | ..... | ..... |

a Revised.

# Modern Material Handling Methods In the Cement Industry

Written Expressly for Pit and Quarry, By C. H. Sonntag*

**Part III.**

Part I of this article, which appeared in the May first number of Pit and Quarry, covered material handling from the deposit to the crusher; from the crusher to the mill by belt conveyors, surface cars, aerial tramways, etc.; in dry process mills in grinding and kiln feeding; and in wet process mills by centrifugal pumps, plunger pumps, compressed air and bucket elevators.

Part II which appeared in the May fifteenth number of Pit and Quarry, covered kiln feeding in wet process mills, clinker from kilns, clinker elevators, pivoted bucket conveyors, clinker storage, the clinker grinding department, belt conveyors, the stock house and packing, bad handling, the coal mill, locomotive cranes, bridge cranes and material handling in general.

Part III, which is the last of the series, is in reality a supplement to the section in Part II on the coal mill and deals with the Fuller-Kinyon Conveyor System for handling ground raw mix, cement or powdered coal—Editor.

A PAPER on material handling in the cement industry would not be complete without mentioning the latest development in dedevices for transporting powdered materials.

Every cement man knows that ground raw mix, cement or powdered coal when allowed to stand in a bin for a while will pack to such an extent that it will stand for some time with an almost vertical face when the bin is opened. It is also common knowledge that these same materials when mixed with a little air become very mobile, spreading out into thin layers, flowing through small openings, and in general acting more like fluids than solids, and in this condition they can be moved with but little resistance.

The Fuller-Kinyon conveying system makes use of this peculiar property to enable such materials to be transported distances that would be prohibitive with the older types of conveyor.

The basic device, on which the entire system depends, is the pump, which is illustrated in Figure 2. It consists of a specially designed worm or screw conveyor running at high speed in a closed casing, and fed through a hopper. The bearings are so designed as to prevent dust from working into them. The pitch of the screw decreases towards the discharge end, so that the powder packs in it much after the manner of the domestic food chopper. At the end of the conveyor is a ring through which air is forced into the material through a large number of small radial holes. This air changes the nature of the load from a dense mass to a mobile semi-fluid, in which condition it is easily forced to its destination. The air in the ring is prevented from blowing back into the pump barrel by the packed material in the end of the screw, which acts as a seal. The air pressure in the ring may vary from 5 to 75 pounds per square inch, depending on the nature of the material and the distance and elevation it is to be carried. This air is supplied through a reducing valve, which after once being properly set need not be disturbed as long as conditions remain unaltered.

The conveyor proper consists of ordinary black iron or steel pipe whose size may be from 2½ to 8 inches, depending on the size of the pump and the capacity required. It is made up with special flanged joints to insure a smooth interior surface, and changes in direction are made by long radius bends. The pipe line may be supported in any convenient way, may be overhead, on or under the ground, and may have any reasonable number of bends to avoid obstacles or to keep the pipe-line out of the way.

To avoid clogging, a small air pipe parallels the main line and is tapped into it through a hand valve at about every other joint. In case of stoppage these valves can be opened successively until the obstruction is reached and blown out. This small pipe also supplies air to the electro-pneumatic switching valves to be

*Consulting Engineer, Cape Giraudeau, Mo.

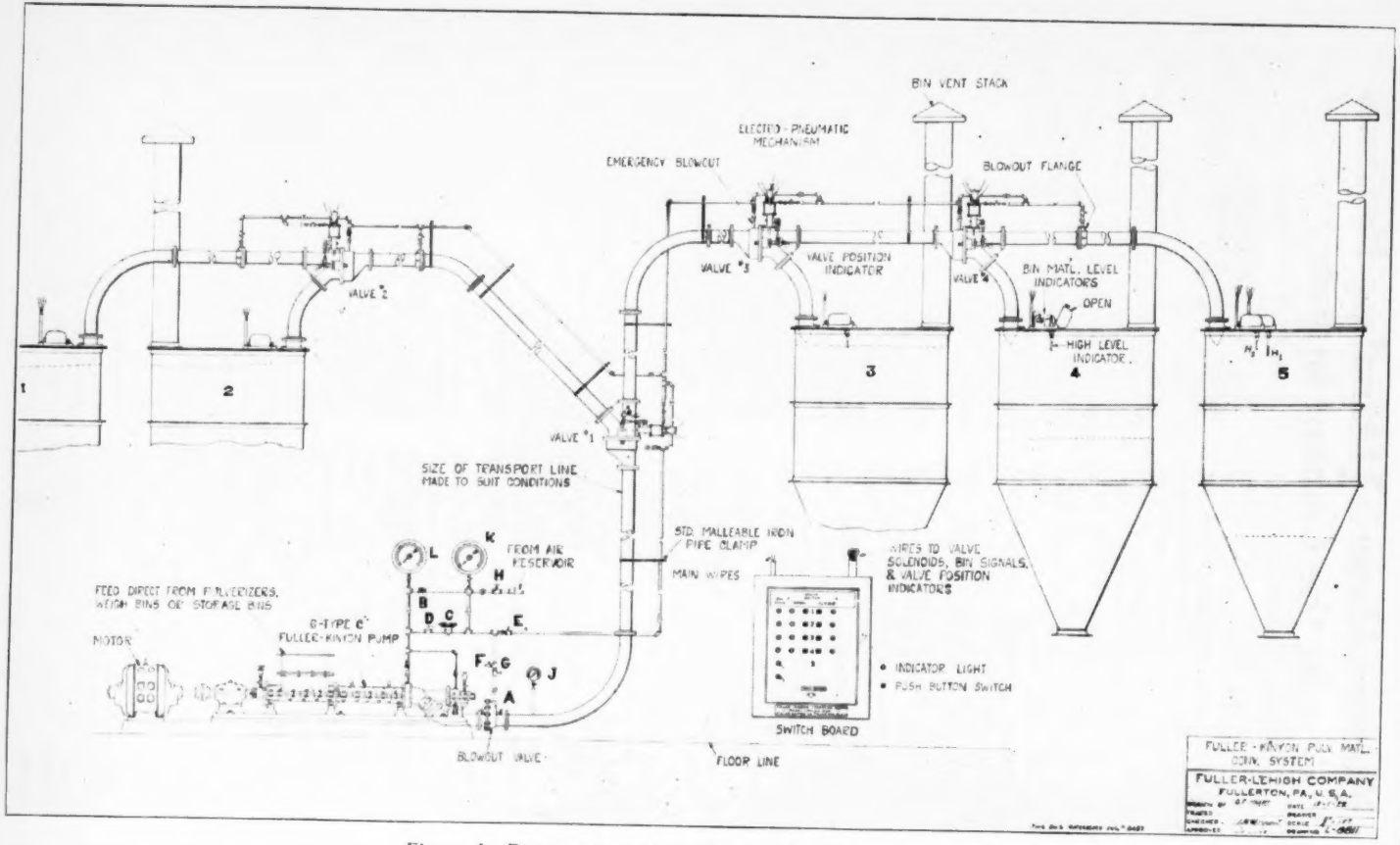



Figure 1—Diagram Layout of the Complete Conveyor System.

presently described. Feed to the hopper C may be from a conveyor, weigh bin, storage bin or directly from a pulverizer.

Figure 1 shows diagramatically how the complete conveying system has been developed, based on the pump just described. The pipe line is shown leading to several bins, the flow of material being controlled by valves that have been specially designed for this purpose. They may in emergencies be operated by hand, but are best electrically controlled from a single station, either manually or automatically. There is one of these valves for each bin except the end one, and other valves may be used in case the line is to be branched, as at valve Number 1. Each bin is also fitted with a high level indicator which can be used to signal the operator when the bin is full or to control the valves or both.

The valves are worked by compressed air which is admitted to the working cylinders by electric solenoids which are energized by the bin indicators or by push-button control from the switchboard. In order to show the position of the valves, each is provided with a "mercoid" switch.* This is a remarkably simple and ingenious device which should appeal to cement mill electricians who have had trouble with small air-contact switches on account of dust. It consists of a short glass tube with closed ends, mounted so as to tilt toward one end or the other in accordance with the position of the device which controls it. The tube has an open electric circuit sealed through the glass at each end, and contains a globule of mercury, which rolls to the end that happens to be low and completes the circuit across the terminals sealed into that end. When the inclination of the tube is reversed, this circuit is opened and the one at the other end closed.

The high bin indicator consists of a paddle hanging vertically in the bin, pivoted near its upper end and connected to a mercoid switch. When the bin is filled to the desired level, additional material flowing in pushes the paddle out of the perpendicular and reverses the position of the mercoid switch.

To show how the system works we may follow the sequence of operation in Figure 1. All the distribut-

*Made by the Federal Gauge Co., Chicago

Figure 1—Diagram Layout of the Complete Conveyor System.

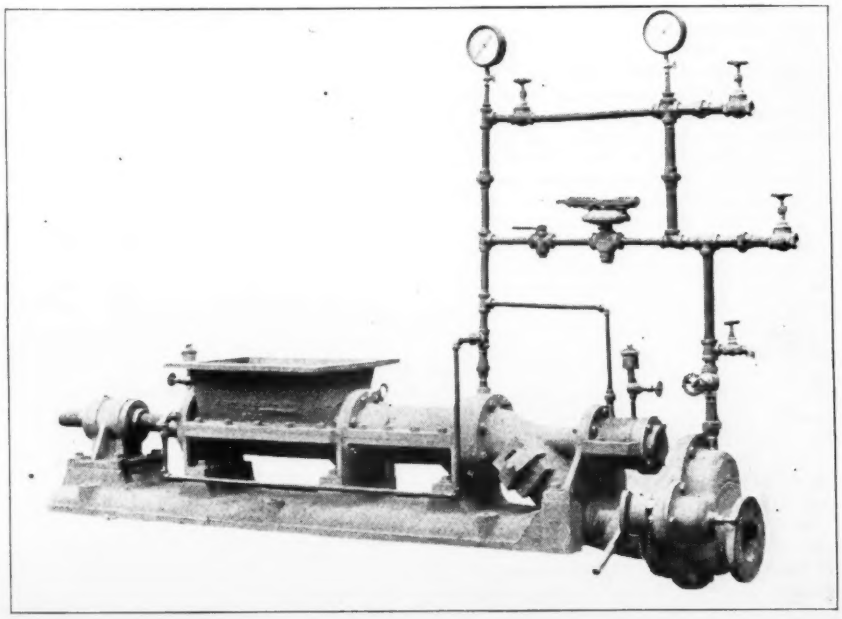


Figure 2. The Fuller Kinyon Pump.

ing valves are opened to their branch lines by the push-button controls on the switchboard. Air is turned on through the reducing valve C and flows through the air ring on the pump into the conveying line. The pump is then started and fed with material, which will flow first into bin No. 2. When this is full enough its high level indicator inverts its mercoid switch, closing the circuit which throws the valve Number 2 from branch to main line position, turning material into bin Number 1. When it is filled, its high level indicator automatically throws Number 1 valve and the flow goes to bins 3, 4 and 5 successively. The last bin has two high level indicators $H_1$ and $H_2$, the suspended paddle on $H_1$ being lower than on $H_2$. These two indicators are not connected to any of the valves, but $H_1$ is in circuit with a Klaxon horn or other signal and $H_2$ with the pump motor control. When the bin fills up to the lower paddle, the signal warns the operator that the bins are full. If he takes no action and the bin continues to fill, indicator $H_2$ will stop the pump in time to prevent an overflow.

The Fuller-Kinyon pump has several marked advantages as compared with the older systems of conveying and elevating.

1. Cleanliness. Once the material is in the pump there is no reason why there should be the slightest escape until final discharge. Pump and pipe line are absolutely dustless.

2. Simplicity. The worm in the pump is the only moving part in the entire system, so that repairs are confined to the pump itself.

3. Combination of functions. With the old methods, material could be lifted only by a bucket elevator, which involved a special drive and was a prolific source of dust. The new system combines elevating and conveying in one operation.

4. Safety. The only place where power is used is at the pump, and the working part is completely enclosed. There is no danger of injury in screw conveyors or the gearing of elevators.

5. No fire hazard. When an inflammable material such as coal dust is being pumped, the amount of air mixed with it is far below that required to produce an explosive mixture, and this coupled with the entire absence of dust along the pipe line makes the system a far better fire risk than the older ones. When discharging into a bin the air leaves the mixtures so quietly that only a small vent sack is required, from which very little dust escapes.

6. Adaptability. This system gives the designer much greater freedom in laying out his conveying and elevating than the older ones permitted. The pipe line may be run up, down or on a slope and around corners without in the least interfering with successful operation. Distances may be considered that would not have been thought of with any of the older devices.

7. Ease of installation. There is no comparison between the labor and other costs of assembling the pipe line with that of screw conveyors and elevators.

8. Dependability. There is nothing about the pipe line to wear out. Repairs are confined to the pump, and these are easily and quickly made. Absolute freedom from lost time may be assured by providing two pumps discharging into one pipe line, so that one may be working while the other is under repair.

As with any other method of material handling, the power required will vary with the tonnage, distance of travel and height of elevation. The needs of the Fuller-Kinyon system compare very favorably with those of the older methods in this respect. The air consumption will also be variable, and as a very rough estimate about eight cubic feet of free air per cubic foot of coal dust will be needed. With other substances the consumption will vary with the nature of the material. The pressure will vary with the size and length of pipe line and the height of elevation. The writer has seen coal dust carried horizontally over 300 feet and elevated about 50 feet with air pressure of less than ten pounds.

While the Fuller-Kinyon system was originally developed to handle powdered coal, and many important installations for that purpose are in daily service, its advantages have caused it to be applied to other materials also. In cement mills its use on ground raw material and finished cement has passed the experimental stage, and it will undoubtedly find a place in other industries. The following table, furnished by the manufacturer, shows the capacities

of the different sizes of pumps on coal dust and cement.

| Size of Pump inches | Size of Line inches | Pulv. Coal Tons per hour | Cement Barrels per hour |
|---|---|---|---|
| 4 | 2½ | — 3 | — 45 |
| 6 | 3 | 3— 7 | 45— 90 |
| 6 | 4 | 7—13 | 100—150 |
| 6 | 5 | 13—20 | 175—210 |
| 8 | 5 | 20—30 | 225—400 |
| 8 | 6 | 30—40 | 400—700 |
| 10 | 8 | 40—75 | 700—800 |

As previously stated, the power, air pressure and cubic feet of free air per minute required by any particular pump will depend on the actual conditions under which it is used.

There are too many of these systems handling powdered coal to make it worth while to list them. As an indication of what may be done with cement, one pump has been taking hot cement direct from the pulverizers to the silos for two years, and another is said to have handled over 500,000 barrels of cement without the renewal of any vital part.

As to raw material, the writer has seen a 10-inch pump taking the entire product of seventeen 42-inch Fuller mills and at the same time a heavy flow of red-hot dust from the hoppers of three waste heat boilers. This amount was elevated 55 feet and carried horizontally about 100 feet, and through a five-inch pipe instead of the eight-inch one recommended by the manufacturer. This particular installation is arranged very much like Figure 1, in which the bins to the left are storage silos and those to the right are kiln feed bins. When the raw mill is partially or entirely shut down mix can be withdrawn from the silos, fed to the same pump and sent to the kiln tanks, and the whole installation and operation has been entirely successful.

## Ruggles-Coles Issues Bulletin

Dryers for stone, ore, coal, fertilizers and other products are described and illustrated in BULLETIN NO. 22 just issued by the Ruggles-Coles Engineering Co. of York, Pa.

According to this three-page folder, there are eight distinct types of Ruggles-Cole Dryers. Of these, six are illustrated, as are also the dryers for ore, stone, fertilizers and coal.

CLASS A is a double shell, direct heat dryer, especially adapted for rock, stone, sand, coal, coke and ores, built in 10 sizes. CLASS B is a double shell, indirect heat dryer, for drying China Clays, Talc, White Kaolin and such materials as can be dried at a medium temperature and which must not come into contact with gases of combustion, built in 4 sizes. CLASS E, indirect heat, to handle sticky or gummy materials. CLASS F, single shell, direct heat, to handle materials where the moisture to be evaporated is small, or the cost of materials is not of great importance, built in 8 sizes. CLASS W, single shell steam dryer, to handle certain materials which must be dried at a temperature of less than 212° F. Built in 5 sizes.

## Nelson Fordson Loaders

"Nelson—1925" is the title of a new 12-page bulletin just issued by The N. P. Nelson Iron Works, Inc., of Passaic, N. J., describing their Fordson Loaders, Types P, Q, and R, which "Crowd While Loading."

The Nelson Fordson Loader is designed to replace manual labor in, 1—Loading loose materials such as sand, gravel, broken stone, ashes, coal, etc., three inches and less in size, into trucks, wagons, carts or industrial cars; 2—Digging and loading from sand pits and gravel banks; 3—stripping, grading and light earth excavation in solid ground reasonably free from boulders; 4—Mining clays and moulding sands.

It has an all-steel chassis frame mounted on standard Fordson tractor, rigid trussed steel boom with high steel pans around head to protect operator from falling materials, long swivel spout swinging through 180 degrees. Will load trucks either sideways or endwise and permits use of loader in cramped quarters. Has steel roller chains for power transmission, wide face elevator sprockets and heavy combination chains, heavy riveted steel buckets with toothed and reinforced digging edges, and alloy gears running in oil.

So varied is the service which the Nelson can perform they say, and so low the operating cost, that there are but few material moving operations in which it cannot be used to advantage. The claim is made that if the operator has but three men at work shoveling, the Nelson will earn its cost in one year. One man runs it from the platform at side of loader, from where he can see every part of his work, both digging and loading.

# Distribution of Cement

The following figures show shipments from Portland cement mills distributed among the States to which cement was shipped during January, February and March, 1924 and 1925. Portland cement shipped from mills into States, in January, February and March, 1924 and 1925, in barrels a.

| Shipped to | January 1924 | January 1925 | Year 1924 | February 1924 | February 1925 | March 1924 | March 1925 |
|---|---|---|---|---|---|---|---|
| Alabama | 81,010 | 85,410 | 1,871,885 | 141,946 | 103,513 | 166,154 | 177,510 |
| Alaska | 0 | 132 | 6,304 | 0 | 0 | 132 | 294 |
| Arizona | 14,185 | 34,370 | 389,935 | 27,700 | 25,945 | 25,659 | 27,009 |
| Arkansas | 60,791 | 41,376 | 1,099,304 | 54,340 | 44,352 | 82,059 | 72,198 |
| California | 856,997 | 988,883 | 10,772,733 | 757,383 | 753,123 | 850,536 | 1,029,118 |
| Colorado | 35,905 | 42,425 | 1,334,493 | 65,752 | 69,871 | 58,747 | 102,537 |
| Connecticut | 50,230 | 34,810 | 1,576,021 | 38,283 | 50,026 | 73,917 | 113,668 |
| Delaware | 8,431 | 5,786 | 384,228 | 10,088 | 9,444 | 15,035 | 21,766 |
| District of Columbia | 32,480 | 37,285 | 718,146 | 43,695 | 65,176 | 51,768 | 58,474 |
| Florida | 124,981 | 265,463 | 2,155,836 | 154,556 | 227,811 | 157,704 | 272,094 |
| Georgia | 80,789 | 93,062 | 1,406,476 | 75,087 | 98,569 | 104,100 | 140,634 |
| Hawaii | 8,182 | 417 | 40,587 | 6,947 | 0 | 2,953 | 1,500 |
| Idaho | 16,193 | 2,598 | 262,142 | 20,885 | 11,029 | 16,502 | 17,667 |
| Illinois | 397,878 | 463,388 | 13,309,655 | 547,057 | 378,947 | 962,510 | 846,638 |
| Indiana | 126,203 | 139,782 | 5,492,150 | 214,900 | 143,464 | 283,594 | 255,597 |
| Iowa | 51,542 | 53,044 | 3,138,347 | 87,144 | 52,039 | 146,692 | 161,164 |
| Kansas | 46,443 | 33,588 | 2,128,898 | 88,298 | 120,405 | 124,379 | 212,402 |
| Kentucky | 33,644 | 52,013 | 1,727,038 | 51,025 | 68,970 | 103,672 | 115,222 |
| Louisiana | 97,861 | 75,992 | 1,255,952 | 91,162 | 97,638 | 110,922 | 98,193 |
| Maine | 10,447 | 4,837 | 386,092 | 10,751 | 5,238 | 22,975 | 21,702 |
| Maryland | 53,641 | 47,635 | 1,983,993 | 67,471 | 98,231 | 131,737 | 143,291 |
| Massachusetts | 106,833 | 113,101 | 3,352,294 | 98,888 | 134,591 | 188,117 | 257,381 |
| Michigan | 203,148 | 190,905 | 9,335,798 | 229,929 | 248,240 | 424,546 | 437,712 |
| Minnesota | 61,434 | 59,395 | 3,238,161 | 141,008 | 97,034 | 212,160 | 173,618 |
| Mississippi | 25,907 | 29,867 | 507,201 | 29,194 | 28,564 | 28,800 | 35,778 |
| Missouri | 75,714 | 115,141 | 3,929,248 | 134,634 | 162,992 | 201,370 | 379,157 |
| Montana | 4,261 | 5,334 | 202,541 | 6,443 | 6,093 | 10,033 | 16,450 |
| Nebraska | 47,874 | 31,832 | 1,496,892 | 49,306 | 46,281 | 78,210 | 99,780 |
| Nevada | 1,335 | 2,492 | 90,949 | 4,251 | 5,177 | 6,258 | 7,254 |
| New Hampshire | 11,482 | 9,419 | 377,917 | 15,734 | 15,911 | 27,155 | 27,592 |
| New Jersey | 229,051 | 157,612 | 6,345,124 | 194,146 | 243,534 | 373,059 | 498,227 |
| New Mexico | 7,796 | 7,911 | 236,644 | 16,129 | 10,320 | 16,007 | 18,865 |
| New York | 562,858 | 400,896 | 17,282,302 | 518,381 | 587,674 | 1,043,786 | 1,159,830 |
| North Carolina | 86,661 | 79,817 | 2,846,808 | 120,775 | 128,770 | 161,171 | 200,097 |
| North Dakota | 1,958 | 1,380 | 270,354 | 3,277 | 3,742 | 15,741 | 16,589 |
| Ohio | 249,298 | 259,628 | 9,201,578 | 317,151 | 271,075 | 501,408 | 592,069 |
| Oklahoma | 97,193 | 58,872 | 2,201,699 | 147,337 | 155,083 | 162,654 | 203,161 |
| Oregon | 33,227 | 54,117 | 1,205,672 | 63,985 | 60,816 | 90,932 | 103,813 |
| Pennsylvania | 389,298 | 288,916 | 12,950,829 | 387,651 | 421,519 | 641,390 | 808,636 |
| Porto Rico | 0 | 0 | 6,686 | 0 | 0 | 0 | 0 |
| Rhode Island | 18,385 | 15,668 | 612,344 | 17,657 | 17,908 | 30,219 | 54,083 |
| South Carolina | 38,077 | 46,840 | 571,372 | 43,033 | 73,312 | 49,767 | 72,929 |
| South Dakota | 5,610 | 4,331 | 472,154 | 18,052 | 14,528 | 36,289 | 40,697 |
| Tennessee | 63,721 | 69,669 | 1,590,992 | 69,912 | 87,499 | 104,162 | 116,856 |
| Texas | 237,761 | 260,540 | 3,844,187 | 231,256 | 345,057 | 295,361 | 381,320 |
| Utah | 8,378 | 3,794 | 429,630 | 20,603 | 16,821 | 30,921 | 28,567 |
| Vermont | 21,778 | 3,129 | 337,146 | 10,833 | 3,060 | 13,614 | 10,312 |
| Virginia | 85,440 | 54,445 | 1,685,953 | 78,029 | 95,942 | 141,142 | 132,891 |
| Washington | 102,917 | 85,969 | 1,831,348 | 81,153 | 90,669 | 153,249 | 151,814 |
| West Virginia | 49,066 | 45,912 | 1,663,250 | 54,328 | 56,629 | 72,567 | 85,703 |
| Wisconsin | 58,334 | 113,396 | 4,357,044 | 136,899 | 73,320 | 239,493 | 142,620 |
| Wyoming | 6,881 | 3,492 | 328,221 | 11,266 | 9,181 | 13,079 | 16,358 |
| Unspecified | 54,183 | 15,964 | 684,598 | 51,524 | 26,430 | 55,950 | 46,236 |
| | 5,133,692 | 5,092,090 | 144,927,151 | 5,857,234 | 5,961,563 | 8,910,357 | 10,205,073 |
| Foreign countries | 76,308 | 69,910 | 819,849 | 75,766 | 53,437 | 84,643 | 73,927 |
| Total shipped from cement plants | 5,210,000 | 5,162,000 | 145,747,000 | 5,933,000 | 6,015,000 | 8,995,000 | 10,279,000 |

a Includes estimated distribution of shipments from three plants for February and March, 1924; from four plants for January and February, 1925; and from five plants for March, 1925.

# The Manufacture of Fire Clay Brick

Written Expressly for Pit and Quarry, By R. F. Hess*

CLAYS used in the manufacture of Pennsylvania fire brick are of three kinds, namely: Flint or hard clay, semi-flint or semi hard clay and soft clay. The flint clay, as the name implies, is a very hard flinty rock which in itself has practically no bonding qualities. The semi-flint clay which we use is of practically the same analysis as the flint clay, the difference being that the clay in the raw state is not nearly so hard as the flint clay and develops a considerable amount of plasticity. This semi-flint clay is used as a bond in the highest grade brick.

The soft clay is still softer in texture than the semi-flint clay. When ground and mixed with water it develops a great deal of plasticity. A small percentage of the soft clay is sufficient to bond flint clay into brick.

The flint and semi-flint clays are both found in the same vein. This vein or seam of clay is located below all the coal measures. The soft clay that is used in the manufacture of fire brick in our section of Pennsylvania is found a short distance under the middle Kittanning vein of coal.

The veins of clay in this section run from four to ten feet in thickness and lay nearly horizontal in the hills. Prospecting is done by digging holes into the edge of the vein of clay where it outcrops on the hillsides and by boring holes down through the rock into the clay where the over-lying rock strata is thick. This drilling is done with what is known as a diamond or core drill. Diamonds or black carbons are set in the end of the rod, which revolves rapidly and cuts a small core through the entire rock strata. This core is retained in the center of the hollow rod by means of core lifter and is removed every four or five feet. The clay cores are carefully preserved for future examination. The sand or cuttings are washed out with water which likewise keeps the diamonds from running hot. The diamonds used in a single bit cost from $1,500.00 to $4,000.00, depending on the size of the core desired. This bit is very frequently lost and never recovered. The flint clays are found only in widely scattered basins or pockets and the locating and prospecting of these clay deposits is the source of a great deal of expense to the brick manufacture.

The samples and cores of fire clay secured by the prospecting are carefully examined and analyzed to determine the quality. The greater percentage of the clays found are too high in impurities to be used in the manufacture of fire brick. This makes it necessary to thoroughly prospect and test out the clays years in advance of the mining in order that the manufacturer may know definitely that he is going to be able to maintain the standard quality of his product. The impurities most common in fire clays are sand and iron. Sand is detrimental to the bond of a fire brick, and the effect of iron in a fire brick to be used in a furnace melting iron is self evident. Iron up to 3½ per cent is not particularly detrimental to a fire brick.

After the clays have been drilled and tested and the quality determined, a mine is started into the vein. This developing consists of a mine opening, railroad and tramway tracks for the transportation of the clays to the factory, tipples and numerous other buildings and structures.

The clays are secured by driving tunnels into the vein. In driving these tunnels the clay and rock are drilled and blasted out with dynamite. The clays, after having been blasted from the solid, are broken up with sledge hammers into pieces that one man can lift into a mine car. After the clay has been broken up and carefully sorted it is loaded into mine cars of about two tons capacity, and then hauled out of the mine either by a small locomotive or mules.

The clays are transported from the mines to the factory by a number of different methods. At the factory the clay is run through a roll or jaw crusher which reduces it down to about two inch lumps. These lumps are then elevated and conveyed into bins back of the grinding pans ready to be mixed and made into brick.

Fire brick are made by three different processes known as hand made

*Chief Engineer, Crescent Refractories Company.

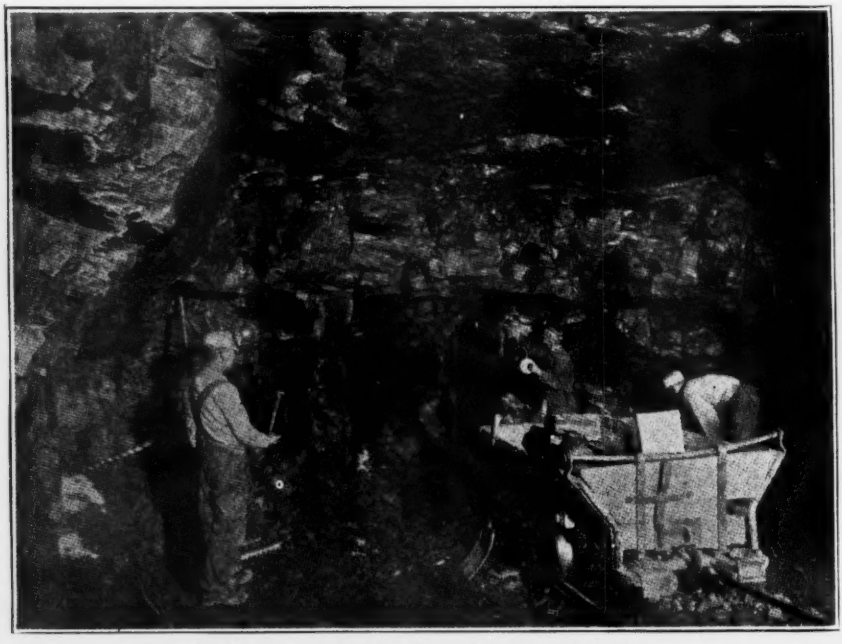
process, steam pressed or stiff mud process, and by dry press. In the hand made process the different clays, including calcine clay, are dumped into what is known as a wet grinding pan where the clays are mixed with water and ground down to the texture desired for the brick. This same grinding mixes the bond clay and the flint clays and works the mass into a suitable consistency for molding the brick into the desired shapes.

Hand molding is the term applied to the process by which this clay mixture, commonly called mud, is molded in wooden molds into the shape of the finished brick. Large special shapes are completely molded and shaped by one operation. Smaller brick, such as the standard 9 and 13½ in. sizes, cupola blocks, etc., are pressed in a hand press having been dried on a hot floor a sufficient length of time to prevent marking from being handled. The shapes that are to be pressed are molded of soft mud, while the mud for large special shapes is made very stiff. Different size shapes require a different stiffness of the mud.

The completely molded shapes and the repressed smaller shapes must be dried on a hot floor for several days or weeks according to size until all the water has been evaporated and the brick are sufficiently dry and hard enough to be placed in the kilns for burning. Large shapes must be dried very slowly to prevent cracking.

The clay mixture or mud that is to be used for shapes that are not pressed is seasoned by sweating in a large pile for a day or two before it is molded into shape. The brick that are to be pressed are seasoned on a hot floor several hours between the molding and the pressing. In the seasoning and drying the bond clay acts much the same as cement in concrete. One of the great difficulties with which the brick manufacturer has to contend is the warping of the brick, more particularly tile and larger shapes. This warping is caused by any slight unevenness of drying or of burning in the kilns and is very difficult to control.

In the steam pressed or stiff mud process the clays are ground in what is known as a dry pan. This pan is similar to the wet pan except that the clays are not mixed with water and the bottom of the pan is perforated. The clay after it is ground



An Underground Mine View—Mining Hard Clay.

down small enough to pass through these perforated bottom plates is elevated to a set of screens where it is screened to produce the desired texture for the brick. The clays thus ground and screened are mixed together in the proper proportions and conveyed to a pug mill where they are mixed with water and the mud pugged into the consistency necessary for molding or shaping in an auger machine.

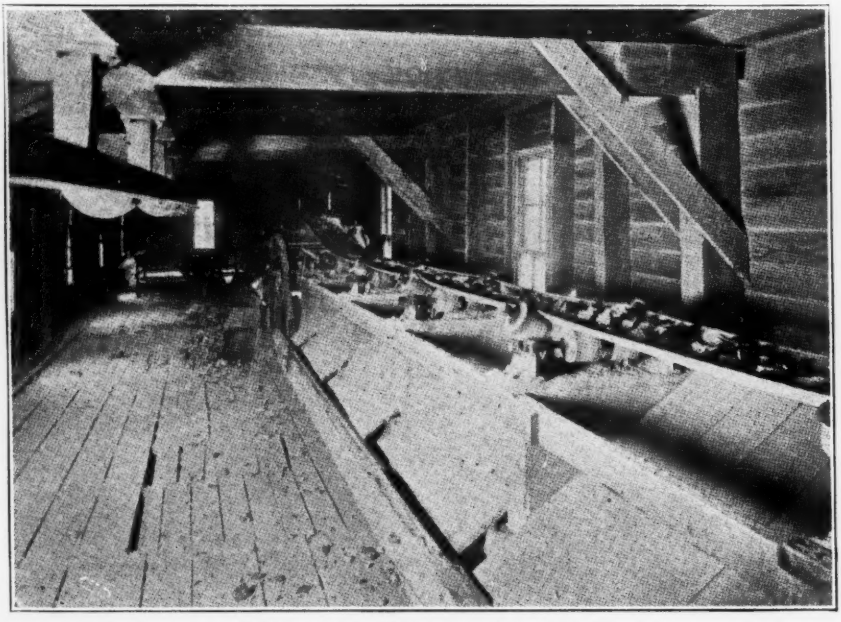
This auger machine forces the clay out into a column of the same length and width as the finished brick. This column is cut into pieces of the desired thickness of the brick. At this stage of the process what is called a wire cut brick has been produced. What is known as a steam pressed brick is produced by running these wire cut brick through a repress which shapes them more uniformly than the wire cut brick.

The brick are then piled on dryer cars and run into what is called a drying tunnel where they are seasoned and dried for several days. After the brick have been thoroughly seasoned and dried in these tunnels they are taken to the kilns for burning.

In the dry press process the clays are ground and mixed the same as for the stiff mud process. Instead of going to the pug mill the clay mixture is conveyed to a hopper on top of a dry press. This clay runs into the molds of the press and is pressed into shape in one operation. Each mold holds just enough clay to make a uniform sized brick. The dry press consists of four to six molds. The brick are taken direct from the dry press to the kilns for burning. The seasoning and drying is accomplished by slow firing in the kiln.

The brick in the kilns must be fired very slowly with a gradually rising heat for several days in order to remove all the moisture without causing undue warping and cracking. After all moisture has been removed the brick are burned at a high temperature for three or four days to thoroughly calcine the clays and remove the shrinkage. After the brick have been thoroughly burned the kilns must be cooled slowly to prevent the brick from cracking.

The refractoriness of any fire brick is governed by the quality of the clays of which the brick are made. As clays cannot be refined in the way that most metals can be the only way to produce a genuine first quality



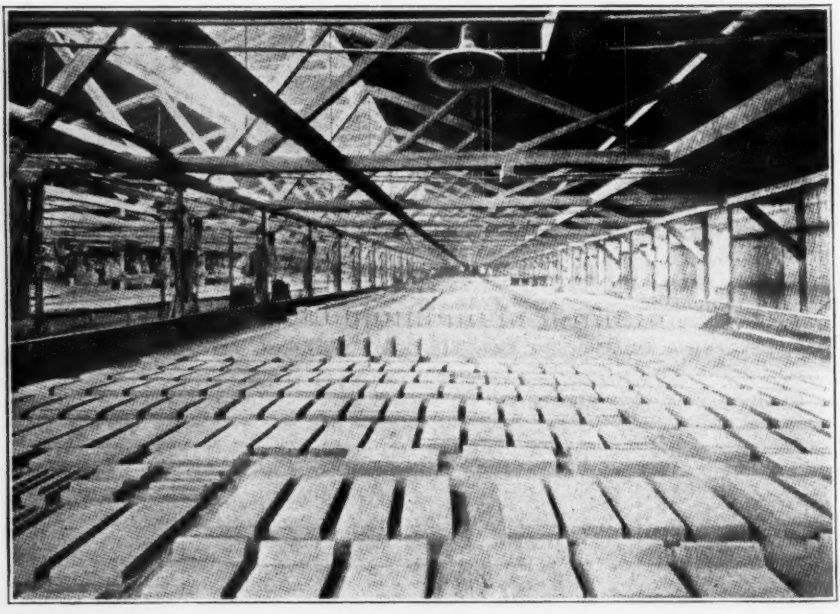
Interior View Showing Belt Conveyor.
— The Clay Distributor.

product of clay is to place therein first quality material. All clays have certain fixed characteristics which can not be changed. In other words the analysis of the clay is not materially changed during the process of manufacturing it into a fire brick. About the only change that takes place is that all of the moisture is driven out. In this driving out of the moisture the clays naturally shrink.

The shrinkage caused by the driving off of the moisture is one of the serious problems that the brick manufacturer has to contend with. Hard burned brick such as are required for many classes of service have practically all the shrinkage removed. Lighter burned brick which are essential for certain classes of service will very often shrink slightly at a temperature higher than that at which they were burned in the kiln.

The classes of service for which fire brick must be designed may be roughly grouped as follows: (This applies more particularly to first quality brick, all of which will be subjected to high temperatures) Abrasion, slag penetration, load carrying capacity and spalling. A dense hard burned brick will naturally best resist abrasion. The ideal brick to resist abrasion would be the brick similar to a paving block, which is made of low refractory soft clay which becomes very dense and hard due to vitrification in burning. A brick of this kind would be worthless as a fire brick due to its inability to stand heat and if you have ever tried heating a brick of this kind and then cooling it suddenly you will have gotten a very clear idea of what is meant by the term spalling as applied to a fire brick. As stated before resistance to abrasion is obtained by making a dense hard brick. On the other hand resistance to spalling is obtained by making a coarse textured brick which does not contain any clays that will vitrify. Furthermore this brick to give the best results must be of a light burn.

It can readily be seen that a brick which will withstand the maximum amount of abrasion and be the most resistant to spalling is practically out of the question. For this reason the ideal brick will probably never be produced. The manufacturers problem is to know the conditions under which the brick are to be used and to then manipulate the clays in the mixing, grinding and burning to



Hot Tile Floor.

best meet the particular class of service.

The ability of a fire brick to withstand slag penetration and likewise its ability to carry a heavy load at high temperatures is governed largely by the density of the brick and the temperature to which it has been burned. Manufacturers of fire brick often have their entire list of products condemned by reason of a brick that has been designed for one class of service used under conditions for which it was never intended.

When you stop to consider that in the manufacture of fire brick a great deal of money must be spent to find the raw clays and that the clays must be mined, crushed, ground, molded, pressed, dried and burned, the selling price of slightly over one-half cent per pound for the finished products is very low. At that price it is practically impossible to have brick handled as gently as would be necessary to avoid knocking off any corners. At the same time brick are likely to warp to a certain extent in the kilns. This warping can not be eliminated by machining as in the case of a metal casting. This might be practical if the selling price would justify the additional labor.

A better understanding on the part of many consumers of the troubles and problems of the brick manufacturer would prove beneficial to both the manufacturer and consumer. On the other hand the better the manufacturer understands the consumer's problems the better they can produce a brick that will give the best service. Closer co-operation between the manufacturer and the consumer and a better understanding of each other's problems will eliminate a lot of grief for both parties.

## New O. & S. Catalog

The material handling machinery manufactured by the Orton & Steinbrenner Co., of Chicago, is described with the help of many excellent engravings in a new publication,—*Catalog No. 7*—just issued.

The purpose of the catalog is described in the Foreword as three fold—first, to assist the industrial executive, engineer or contractor who knows locomotive cranes to choose a suitable machine; second, to acquaint the man who has never used a crane with the possibilities, and third, to describe and illustrate briefly a few of the many types of cranes made by this company.

Twenty-three pages are given to locomotive cranes arranged for traveling on standard or special gauge railroad track mounted on 4 or 8 wheel trucks. Several views of stationary cranes are also shown together with gantry structure and large cranes. Clearance dimensions and capacities are given also.

## Atlas of Traffic Maps

The "Atlas of Traffic Maps," prepared by Wayne E. Butterbaugh, Director of Education, Traffic Management Department, LaSalle Extension University, assisted by Charles E. Wymond, official cartographer, Central Freight Association, is the first attempt to present comprehensive and accurate information concerning the freight rate territories throughout the country on maps prepared for that purpose.

The information contained on these maps is not to be found elsewhere in any one publication, for the sources are of widely varying character. This Atlas has been designed to cover the traffic field in the broadest possible manner. It constitutes a valuable reference work for any producer interested in the problem of transportation.

The Atlas is divided into four large groups, General Traffic, Railroad Association, Railroad Rate and Railroad System. The general maps pertain to the sources of traffic and the present transportation systems of the United States as a whole. This section also includes a map of the main highways of the country. The association maps graphically picture the territorial jurisdiction of the classification committees, freight associations and freight bureaus. A considerable portion of the Atlas is devoted to freight adjustment maps. The railroad system maps illustrate many of the Class I railroad systems of the various sections of the country. This Atlas is published by the LaSalle Extension University.

The Pennsylvania Pump & Compressor Company of Easton, Pennsylvania, announce that Whitman and Brandt, 705 Bona Allen Building, Atlanta, Georgia, has been appointed District Representative for the Atlanta territory.

# U. S. Gypsum Operating Third Lime Plant

THE United States Gypsum Company will on June 5th put into full operation a new lime plant located one mile south Cordova, Ill., It consists of eight steel-jacketed kilns, 12-foot shaft with a daily capacity of 12 tons each, two Clyde (batch-type) hydrators of 60 tons apiece daily capacity, with kiln-house, hydrator-building and warehouse of permanent ferro-concrete construction.

Power is being supplied by the Tri-City Power Company which has installed a 13,200-volt transmission line from East Moline to Cordova. Water is being pumped from the Mississippi river, a short distance from the plant. Transportation is provided by the Chicago, Milwaukee & St. Paul Railroad. The most modern pumping and quarrying equipment, selected in accordance with the Company's experience in other lime-fields, has been installed.

Property was purchased in 1923 after it was found that a large supply of high-quality dolomitic limestone adapted to the manufacture of masons' hydrate was available. A light overburden has been stripped and preparations have been made to open a quarry to a depth of 35 feet for the first level. Construction was begun last Fall and has been carried on by a crew of 200 men. The operation will give employment to 40 men.

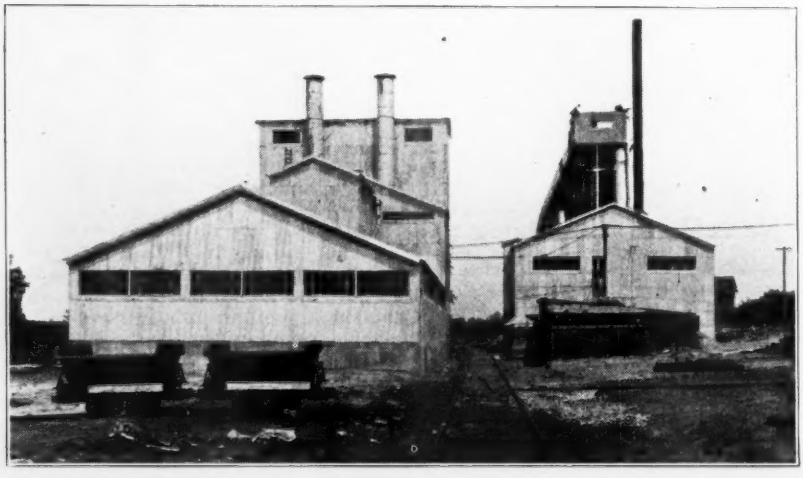
Its output will be about 125 tons a day of mason's hydrate It will be distributed in the Central and Northwestern states, where the acceptance of hydrate instead of lump lime is well established in the building trades. A large part of the output of this plant will be shipped to the United States Gypsum Company's plant at Ft. Dodge, Iowa, to supplement the Company's mixed car service to building supply dealers. Opening of these kilns will mean lower freight-rates on mason's hydrate for dealers in the western states who previously have been served from the Ohio lime field.

This is the third lime plant owned by the United States Gypsum Company, one of 40 kilns being located at Genoa, Ohio, and one of five kilns at Oakfield, N. Y. It is the first factory operated by this concern in Illinois.

### Austin Company Moves

The Austin Company, Engineers and Builders, headquarters at Euclid Ave., Cleveland, announces the removal of its New York office to larger and more efficient quarters in the Equitable Building, 120 Broadway. The New York staff has been increased.

J. K. Gannett is District Manager of the New York office. A. D. Engle and D. C. Raymond are his assistants. The Austin Company reports an increasing volume of industrial construction on the Atlantic Seaboard during the past few months.



New Lime Plant of the United States Gypsum Company at Cordova, Ill., as seen from the south. Warehouse and Hydrator-house are at the Left of the tracks and the Kiln-building is at the Right.

# Factors Governing Modern Lime Kiln Capacity and Fuel Economy

By Victor J. Azbe, Consulting Combustion Engineer*

PART I

ONE very frequently hears of kilns having lime-fuel ratios of four, five, six to one and at times even more, but the students of kilns seldom encounter them. The ratios of two to one are far more frequent. Often in a conversation the ratio is given very carelessly. As a rule, it is inclined to be higher than it is; then also all of the conditions are not stated. Is the lime high calcium, or of magnesium variety? What kind of fuel is used? What type of kiln is employed? All of these conditions make a great deal of difference.

As a rule lime kilns are very inefficient, especially the externally fired kilns which are usually used and to which this paper mainly refers. Thermal fuel efficiency of kilns as low as 25 per cent is common; efficiency as high as from 45 to 50 per cent is scarce. While efficiency higher than this is possible, it is seldom obtained. This is due primarily to the lack of information on lime kiln design, on basic under-lying chemical and physical principles of lime kiln operation, and to the lack of dependable standards for comparison.

Not only is fuel efficiency poor as a rule, but kiln capacity is low, labor high, and often the lime appearance and quality are injured by improper burning. All of this is realized by many lime men and they want to improve, but they lack practical, dependable information on proper kiln design and operation. Even theoretical information dealing with the laws of lime kiln performance is rather meager.

A prominent chemist of one of the largest lime companies in this country stated that the lime industry is where the steel industry was 50 years ago. As far as lime kilns themselves are concerned, I think it would be safe to go much farther back, since some of the very antique kilns of hundreds of years ago compare quite favorably with some of the kilns used today. As to the science of lime burning, they certainly could not have employed less than is employed today by many.

The aim of this article is to try to establish a standard of comparison and to outline on what these standards are based. Much of the information has to be technical; some of it will be in part incorrect and will have to be improved when more and better information becomes available. The discussion will center around higher fuel efficiency, higher kiln capacity, longer kiln running periods and better lime. Some of the subjects will be covered more fully than others, but none will be covered as fully as they deserve since space, time and the knowledge available do not permit.

**Actual Fuel-Lime Ratios Obtained in Various Plants.**

It is often dangerous to generalize, but I will take the chance and make the statement that a lime man should strive for a fuel cost of one dollar per ton of lime. This should be hsi aim regardless of what the purchased fuel cost is, since if the fuel cost is high, his plant should be more carefully designed and operated so as to get a better ratio than the plant obtains where fuel is cheap. There really should be a slogan, "Fuel Cost $1.00 Per Ton of Lime," and leaving out extremes of conditions, this cost should be possible in most cases. In some other cases it can be made nearly possible, and in some it can be bettered. I will admit, however, that to attain this aim is quite difficult in many cases especially so when the plant is improperly designed.

What are the actual ratios, efficiencies and fuel costs obtained in different plants? To answer this question I am giving the results of a few good and of a few poor plants.

Case A. This plant has high calcium stone, 2,000 B. T. U., $5.00 per ton bituminous screened coal. The results were as follows:

Kiln coal only—Ratio 2.33—1.

*A paper prepared for the Seventh Annual Convention of the National Lime Association held at Briarcliff Manor, New York, May 26, 27, 28, 29, 1925.

Thermal kiln efficiency—26.8 per cent.

Fuel cost per ton of lime $2.59.

Kiln and steam coal—Ratio 1.93—1.

Fuel cost per ton of lime $2.59.

Case B. At this plant a good screened coal of 12,000 B. T. U. was burned, the coal costing $4.00 per ton delivered. The following results of two succeeding years include coal for kiln steam and for compressed air and hoisting equipment.

Ratio 2.12—1. Fuel cost per ton of lime $1.88.

Ratio 1.76—1. Fuel cost per ton of lime $2.27.

Case C. This is the same plant as Case B, but under different management. The same coal was burned and the same kiln and firing equipment used. The comparison is given to show how much difference there may be in quality of management.

Ratio 3.3—1.

Fuel cost per ton of lime $1.21.

Case D. This represents the combined results of a number of plants owned by a company. No steam was used; coal was run of mine of about 13,000 B. T. U., and its cost was $4.45 per ton. Lime was high calcium variety.

Ratio 2.65—1. Kiln thermal efficiency 28 per cent.

Fuel cost per ton of lime $1.68.

Case E. In this case coal was cheap, costing $3.75 per ton of 11,000 B. T. U. screened bituminous. Vertical kilns were used with high calcium lime stone. There was some coal used under the boiler, but all steam was used for kilns, so the coal must all be charged to lime.

Ratio 2.04—1. Kiln efficiency 25.5 per cent.

Cost of fuel per ton of lime $1.84.

Case F. In this plant a large, modern rotary lime kiln was used. The coal was of high quality having 13,894 B. T. U. per pound. Its cost was only $3.75 per ton. A modern gas producer was employed to gasify the coal. The ratio includes coal for gas producer boiler, but no steam was used for any other purpose.

Ratio 2.23—1. Kiln efficiency 22.1 per cent.

Fuel cost per ton of lime $1.68.

In five of the above six cases it will be noted that ratios are closer to 2—1 than 3—1. Fuel efficiency is around 25 per cent, and 75 per cent of heat is lost or wasted in some way or other. Fuel costs are closer to $2.00 than $1.00 per ton of lime, and in addition to low fuel efficiency the output per kiln is low and the labor costs per ton of lime high. I think the above five are representative of the majority of lime plants in this country.

There are also plants that are relatively efficient as lime plants go. These plants, however, are a minority.

Case G. Illinois bituminous 12,000 B. T. U. coal is used, screened $4.00 per ton, vertical lime kilns, burning high calcium lime stone.

Ratio 3.75—1. Thermal kiln efficiency 43 per cent.

Cost of fuel per ton of lime $1.07.

Case H. Illinois bituminous 11,400 B. T. U. coal, screenings at $3.65 per ton, high calcium lime stone.

Ratio 3.75—1. Thermal kiln efficiency 45 per cent.

Cost of fuel per ton of lime $0.97.

Case I. Indiana bituminous 11,750 B. T. U. small size, screened, costing $3.75 per ton, high calcium lime stone.

Ratio 4—1. Kiln thermal efficiency 47 per cent.

Fuel cost per ton of lime $0.94.

The above three cases, G, H, and I, are much better than the first five. The ratios are not as high as ratios are talked about but are much higher than are usually obtained. Kiln thermal efficiency is still apparently low but comparatively high. A lime kiln by nature is inefficient, and it is difficult to raise efficiency as high as 50 per cent especially since, in the past, relatively little study was devoted to lime kilns, and so from thermal standpoint they are not well understood. The main points of interest in the three specified cases, are, however, the fuel cost of around $1.00 per ton.

**Heat Distribution in Theoretical Kiln.**

The judging of a lime kiln can be done either by comparing its performance with other kilns or by comparing it with an ideal one. For best results one should do both. An ideal kiln will burn fuel with a theoretically correct amount of air, that is, incomplete combustion will not take place and there will be no excess air. The lime and gas travel will be such that counter-current heat flow transfer will be in effect. The stone outer surface will begin to be converted to lime at a tempera-

ture of about 1400° F., and the inner portions will be decomposed at a temperature of 1650° F. All sensible heat in the burned lime will be retrieved and used for pre-heating of air used for combustion. In the calculations which follow a temperature elevation of only 200° F. will be allowed for heat transfer, which means that the gaseous products of combusion and $CO_2$ driven from the stone will leave the burning zone and enter the pre-heating zone at a temperature of 1600° F.

To decompose one pound of $CaCO_3$ into CaO and $CO_2$ there are 772 B. T. U. required or 1378 B. T. U. per pound of CaO.

If we burn coal having a heating value of 12,780 B. T. U. per pound, the gaseous products of combustion will weigh about 10.40 pounds per pound of coal. If we further assume that lime leaving the burning zone will be at a temperature of 1650° F. (actually it is considerable more), and specific heat is .22, then the sensible heat content of each pound of lime passing into the cooler above the temperature at which it enters the pre-heater will be 350 B. T. U.

Of the heat and in the coal, provided there was no loss by radiation in the furnace and no loss due to the carbon in ash, all will be available for making lime, except that in the products of combustion at the temperature of 1600° F. when some are leaving the burning zone, and that carried off by lime into the cooler above decomposition temperature. Heat capacity of the products of combustion at this temperature is 4250 B. T. U., or 33.2 per cent which is not available for lime burning. This figure divided by 1378 B. T. U., required for decomposing 1.785 pounds of $CaCO_3$ equivalent to one pound of CaO, gives us a ratio under these conditions of 6.19 tons of lime per ton of coal.

This amount is slightly increased by the $CO_2$ gas which will be evolved at the temperature of 1650° F. and which will cool and leave the burning zone at a temperature of 1600° F., the difference being used in making lime. The actual amount of this heat cannot be determined, and since it is small, it will be ignored.

One pound of CaO represents .785 pounds of $CO_2$ gas given off in the decomposition zone. The 6.19 pounds of CaO therefore represents 4.86 pounds of $CO_2$ gas, and so the total weight both of the gaseous products of combusion and the $CO_2$ from lime stone is 15.26 pounds. The products of combustion contain at 1600° F., as stated previously, 4250 B. T. U., and the $CO_2$ from lime stone will contain 419.34 x 4.36=2070 B. T. U. or the two together will contain 6320 B. T. U. which is available for pre-heating of the stone.

For 6.19 pounds of CaO there are 11.05 pounds of $CaCO_3$ required, and assuming that the stone is pure and dry, this amount will have to be preheated, part up to 1400° F. and part to 1650° F. before decomposition will begin. Assuming that the specific heat of $CaCO_3$ is .22 and initial temperature is 62° F. and the stone is heated to 1600° F., then the amount of heat required for preheating is 3721 B. T. U., 2609 B. T. U. less than is available in the waste gases.

Next, assuming that all the heat above 62° F. contained in the lime leaving the cooler is retrieved and used for pre-heating air without loss by radiation, then the amount of heat available for lime burning proper will be increased by 2400 B. T. U., and the ratio will become 7.93—1 instead of 6.19—1. Under these new conditions the amount of gas leaving the burning zone will be 16.64 pounds; its heat content at 1600° F. will be 6700 B. T. U. The amount of heat necessary for preheating $CaCO_3$ will be 4850 B. T. U. still sufficient for the theoretical cycle.

Under conditions when sensible heat of lime is not retrieved, the waste gases will contain 45.2 per cent $CO_2$ per volume. When the sensible heat is retrieved, the $CO_2$ percentage will be 50 per cent.

Tabulating these results we get Table I.

It will be noted that even calculation will not permit us to obtain 100 per cent efficiency from conventional kiln. This is due to the location of decomposition temperature level and so there is more heat available for pre-heating of stone than is necessary. It further will be noted that some of the heat used for preheating stone, (that in the $CO_2$ portion of the stone), becomes again available for pre-heating other stone after the $CO_2$ is driven off and passes up through the pre-heating zone. Of the heat obtained from the cooler,

all becomes available for decomposition of stone.

**Kiln Efficiency Rating.**

Boiler performance is always gauged in terms of efficiency, and the figure pounds of water evaporated per pound of coal means very little since evidently not only the boiler itself but also the quality of coal determines that. In the case of a lime kiln the ratio tons of lime per ton of coal means very little since here also coal has a great deal to do with it. To gauge kilns in terms of efficiency, the same as with boilers, is difficult because the kiln is much more complicated and really consists of four different parts; while boilers, as a rule consist of only two. The kiln has a coal grate or gas burner; it has a cooler, a decomposition zone and a pre-heating zone.

If the grate or burner performance is poor, the best of the kiln will not give good results, and evidently the performance of the two should be distinguished from each other. Inefficiency, caused by insufficient amount of heat generated or heat delivery in improper form is certainly chargeable to this appartus and not to the kiln. The cooling zone of the kiln should act as an air pre-heater as it would be far more important than it is as a lime cooler, but this, due to various difficulties, is seldom utilized.

The most important zone of the kiln is the burning zone. Here all heat of high temperature elevation, that is, from around 1600° F., is utilized. This zone cannot utilize heat below this level no matter how much heat at this temperature is furnished to it. If the coal grate or burner delivers heat of low temperature elevation, caused by excess air, radiation or incomplete combustion, evidently the burning zone cannot perform right even if it is of an efficient design.

The function of the pre-heating zone is in part rock storage, but mainly it is a zone where the heat exchange between the cooling gases and the heating lime takes place. Here, as well as in the burning zone, the hot gas flow distribution may not be right or stone may not travel down in proper sequence and the performance of the entire kiln may be upset and poor results be obtained even if the other zones are performing their duty.

Due to this each zone should be judged on its own account, but as that is not fully possible, an expression covering all four must evidently be developed. Before this can be done, one must know how much heat is required to make a pound of lime. That is a knotty problem. We, of course, know the heat required to decompose a pound of stone, and we can also determine how much heat is required to pre-heat the stone up to calcining temperature. But during decomposition the $CO_2$ that escapes carries off heat which becomes available for pre-heating, so in the last analysis there is not as much heat necessary for pre-heating as we first assumed. Thus a possible basis for figuring efficiency disappears.

If it were possible to operate a kiln with cold top and cold bottom, that is, have the waste gases and the finished lime leaving at the temperature of entering air, then the efficiency could be based upon only the heat of decomposition of lime stone. But while cold bottom is possible in the theoretically ideal kiln, even this kiln will not give a cold top, and efficiency certainly should not be based upon something that is theoretically impossible.

If in the theoretically ideal kiln we should pre-heat only part of the air with the lime in the cooler and pre-heat the other air used for combustion with an economizer located beyond the pre-heating zone, then a cold top and cold bottom condition would result. The kiln efficiency could then be based on heat required to decompose $CaCO_3$ or $MgCO_3$ without any consideration of the amount of heat necessary for pre-heating. The amount of heat required for decomposing $CsCO_3$ for one pound of CaO is 1378 B. T. U., and $MgCO_3$ for one pound of MgO is 977 B. T. U. Kiln efficiency determining formula then becomes:

$$\frac{100\ 1378\ C + 977\ M}{H} = E$$

C=Number of pounds of CaO per pound of coal.

M=Number of pounds of MgO per pound of coal.

H=Heat value in B. T. U. per one pound of coal.

E=Thermal kiln efficiency.

In the third column of Table I the conditions that would be obtained in an ideal theoretical installation are given. In this case, all lime is cooled

at atmospheric temperature by part of air later used for combustion, while part of the air passes through an air heater heated by waste gases leaving the kiln top.

This, of course, is all theoretical and is given to show heat distribution. Practically, it is doubtful if one could operate satisfactorily under the last ideal conditions because the air would be pre-heated to such an extent that furnace temperatures would be entirely too high for manufacture of good lime.

TABLE I.

CONDITIONS: High calcium lime stone—pure—dry—no heat loss by radiation. No excess air for burning of fuel. Complete combustion. Temperature of gas at boundary of preheating and burning zones 1000° F. Coal bituminous 12,780 B. T. U. per pound.

SENSIBLE HEAT IN CaO & WASTE GAS

| | Neither Retrieved | CaO Heat Retrieved Only | Both Retrieved | |
|---|---|---|---|---|
| Weight of products of combustion 1 pound coal | 10.40 | 10.40 | 10.40 | lbs. |
| Weight of $CO_2$ from limestone | 4.86 | 6.24 | 7.28 | lbs. |
| Total weight of gas leaving kiln top per pound of coal | 15.26 | 16.64 | 17.68 | lbs. |
| Amount of heat obtained for lime burning from coal direct | 8,530 | 8,530 | 8,530 | B. T. U. |
| Amount of heat obtained from cooling CaO and preheating air | .... | 2,400 | 3,240 | B. T. U. |
| Amount of heat obtained from waste gas and preheating air | .... | .... | 1,010 | B. T. U. |
| Total amount of heat available for lime burning | 8,530 | 10,930 | 12,780 | B. T. U. |
| Heat lost to cooler as sensible heat in CaO | 2,165 | .... | .... | B. T. U. |
| Heat lost in waste gas leaving kiln top | 2,609 | 1,850 | .... | B. T. U. |
| Ratio tons of lime per ton of coal | 6.19 | 7.93 | 9.27 to 1 | |
| Heat used per pound of lime made | 2,075 | 1,620 | 1,378 | B. T. U. |
| Kiln efficiency | 62% | 85.5% | 100% | |
| $CO_2$ per centage in waste gas by volume | 45.2% | 50% | 53% | |

## The Mann Welder

A new bulletin issued by H. Kleinbans Company of Pittsburgh, Pa., describes the Mann Welder, an electric arc welder said to embody simplicity, operating economy, arc flexibility, penetration, welding speed and current control. How the Mann Welder was developed is described in the following words:

"The Mann Welder is the result of years of research and study of the requirements of the electric arc welding field in both repair and production work. During the time required for the development of The Mann Welder its designers have handled large repair and production work throughout the United States and Canada, on both ferrous and nonferrous metal. Large welding jobs and production work which had to be accomplished in the shortest possible time under abnormal conditions emphasized the necessity of an electric arc welder which combined simplicity, operating economy, arc flexibility, penetration, welding speed and current control. At first it seemed an imposibility to design a direct current arc welder which would combine all of these essential points, but after extensive study the difficulties were overcome one by one and The Mann Welder, which embodies all these qualities, was developed."

The Mann Welder is manufactured in stationary and portable motor generator sets, to operate on any type line characteristics either direct or alternating current. Also it is made in gasoline engine driven sets for use where suitable electric current is not available. The gasoline engine driven sets are mounted on either skids or wheels.

## Recent Patents

The following patents of interest to readers of this journal recently were issued from the United States Patent Office. Copies thereof may be obtained from R. E. Burnham, patent and trade-mark attorney, Continental Trust Building, Washington, D. C., at the rate of 20 cents each. State number of patent and name of inventor when ordering.

1,533,316. Mining-Machine. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co., same place.

1,533,317. Mining-machine. Morris P. Holmes, Claremont, N. H., assignor to Sullivan Machinery Co., same place.

1,533,512. Bucket. Almon E. Norris, Brookline, Mass.

1,533,658. Crusher. Ray C. Newhouse, Wauwatsa, Wis., assignor to Allis-Chalmers Mfg. Co., same place.

1,533,910. Dredge-bucket and lip therefor. George R. Hanks, High Bridge, N. J., and Gerritt V. Wood, Oakland, Calif., assignors to Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

1,533,991. Crusher. Arthur J. Jorgensen, Milwukee, Wis., assignor to Allis-Chalmers Mfg. Co., same place.

1,534,000. Ball-mill lining. Raymond H. Baker, New York, N. Y., assignor to Taylor-Wharton Iron & Steel Co., High Bridge, N. J.

1,534,185. Cableway and method of operating the same. Thomas S. Miller, South Orange, N. J.

1,534,461. Mining-machine. Edward O'Toole, Gary, W. Va.

1,534,462. Mining-machine. Edward O'Toole, Gary, W. Va.

1,534,463. Longwall-mining machine. Edward O'Toole, Gary, W. Va.

1,534,855. By-pass for feeding mechanism for crushers. Harry N. Lowenthal, Philadelphia, Pa., assignor to R. H. Beaumont Co., same place.

1,534,891. Skip hoist. Robert H. Beaumont, Radnor, Pa., assignor to R. H. Beaumont Co., Philadelphia, Pa.

1,534,892. Screen. Robert H. Beaumont, Radnor, Pa., assignor to R. H. Beaumont Co., Philadelphia, Pa.

1,535,120. Method of separating high content phosphate from low-content phosphate and clay or the like. Samuel B. Kanowitz, Greensburg, Pa., and Hyleman A. Webster, Columbia, Tenn.; said Kanowitz assignor of his rights to Raymond Brothers Impact Pulverizer Co., Chicago, Ill.

1,535,381. Shoveling-machine. Harold I. Stage, San Francisco, Calif., assignor to Ingersoll-Rand Co., Jersey City, N. J.

1,535,509. Excavating apparatus. Pasquale Ursino, Seattle, Wash.

1,535,663. Drag-scraper equipment. William E. Hale, Fort Washington, Pa., assignor to R. H. Beaumont Co., Philadelphia, Pa.

1,535,664. Drag-scrapper equipment. William E. Hale, Fort Washington, Pa., assignor to R. H. Beaumont., Philadelphia, Pa.

1,535,878. Grab-bucket. John S. Townsend, Harvey, Ill., assignor to Whiting Corporation, same place.

1,535,948. Sand cutter or mixer. Elmer A. Rich, Jr., Chicago, Ill., assignor to American Foundry Equipment Co., New York, N. Y.

1,536,131. Mining-machine. Thomas E. Pray, Chicago, Ill., assignor to Goodman Mfg. Co., same place.

1,536,282. Shoveling and loading machine. John C. Brackett, Phillipsburg, N. J., assignor to Ingersoll-Rand Co., Jersey City, N. J.

1,536,327. Mining-machine. Frank Cartlidge, Cincinnati, Ohio, assignor to Sullivan Machinery Co., Claremont, N. H.

1,536,422. Mining-machine. Frank Cartlidge, Cincinnati, Ohio, assignor to Sullivan Machinery Co., Claremont, N. H.

1,536,491. Pebble-mill. Charles J. Gunderoth, Copperhill, Tenn.

1,536,608. Power-shovel. Paul Burke, Green Bay, Wis., assignor to Northwest Engineering Co., same place.

1,536,609. Power-shovel. Paul Burke, Green Bay, Wis., assignor to Northwest Engineering Co., same place.

1,536,795. Draft device for mining-machines. Charles E. Davis, Chicago, Ill., assignor to Goodman Mfg. Co., same place.

1,537,163. Crusher. Anthony P. and Charles P. Giunta, Philadelphia, Pa.

1,537,377. Ore-pulverizer. George E. C. Rousseau, Sacramento, Calif.

1,537,564. Gyratory cone crusher. Edgar B. Symons, Los Angeles, Calif., assignor to Symons Brothers Co.

1,537,565. Process of crushing hard materials. Edgar B. Symons, Los Angeles, Calif., assignor to Symons Brothers Co.

# Lime in Dirt Roads

By E. J. McCaustland, Dean, University of Missouri*

FROM time immemorial man has recognized that the formation of mud after rains always interposed a serious bar to his physical and material progress. Whether he attempts to proceed on foot or on horseback; by coach or by automobile, "mud" has ever been, and still is, anathema! Except for travel in the arid regions he has escaped the curse only by great effort and expense or by having recourse to some form of floating conveyance on the surface of the waters or in the air above his head. Although he has not succeeded in conquering the earth, he has not hesitated to invade both sea and sky.

Now on the surface of the earth in all regions where men live there are many varieties of soil; and if these soils are silts, loams or clays, they will, when wet, become sticky and cling to the feet of both man and beast as well as to the wheels of moving vehicles. Furthermore, when soils are wet their bearing power is quickly lost, traffic breaks through the surface and ruts are formed which tend to grow deeper and deeper as traffic continues. The common agricultural soils containing silts, loams or clays are never entirely suitable for all-weather roads; and yet it is likely that more than eighty per cent of all our country and by-roads for generations to come will of necessity be constructed upon and of such soils. It is a pressing problem to know what can be done to improve this situation. Underdrains and surface ditches have had thorough trial and have done something to lessen the difficulties of the problem. Transverse sections with all ranges of crown from high to low have been tried and found to be merely palliative; sand has been incorporated with clays and a reasonable degree of success attained; but in the main the actual area of muddy roads in the United States is increasing rather than decreasing from year to year.

It was to be expected therefore that the recent expansion of the road building program in the United States in the field of the so-called "permanent highways" should result in greater interest in some means of improving the roads subject to continuous maintenance. In the fall of 1923 the Engineering Experiment Station of the University of Missouri entered into a co-operative agreement with the National Lime Association to conduct field and laboratory investigations in an attempt to determine the effect of the use of commercial lime on earth roads with the hope of reducing both the inconveniences and the expenditures caused by the formation of mud. The work was placed directly in charge of Mr. Horace W. Wood, Jr., as Research Fellow in the Experiment Station and the material used in the investigation was donated by some of the constituent companies of the National Lime Association.

Laboratory tests were begun in December, 1923, for the purpose of determining the more obvious physical characteristics of the soils under investigation and to become acquainted with the changes wrought in those characteristics by the addition of pre-determined percentages by weight of lime. At a somewhat later time selected stretches of clay roads, subject to heavy traffic, were treated with varying percentages of hydrated lime, and these stretches have been kept under observation for a number of months. The winter season of 1924-25 has been an extremely trying one on these tests roads because of a heavy fall of sleet and ice early in December and a continuation through the winter of alternating periods of thawing and freezing. In every case, however, these test sections, all of which have been carrying traffic during the past seven to eleven months, show to the most casual observer the distinct advantage of lime admixtures in preventing surface stickiness and the formation of deep ruts under traffic. In brief, it seems to have been established beyond question that the addition of hydrated lime in the proportion of from two to five percent dry weight to clay soils will materially reduce the tendency to form mud and prevent to a great degree the formation of ruts. There is reason to believe, however, that such treatment will not in any degree lessen the production of dust, and in some cases the dust may be increased.

*A paper presented at the Seventh Annual Convention of the National Lime Association at Briarcliff Manor, New York, on May 26, 1925.

The following facts are abstracted from Mr. Wood's monthly reports. Early in July, 1924, a stretch of 500 feet of road near Hallsville, Mo., was treated with hydrated lime to a depth of five inches. On 250 feet the proportion used was two per cent by dry weight, and on the remaining 250 feet five per cent by weight was incorporated in the soil. Later a section of road 250 feet long was treated with five per cent of hydrated lime incorporatde to a depth of only two inches for purposes of comparison. These road sections have been under careful observation since the original treatment and especially after rains. The clay and lime mixture does not stick on the wheels of passing vehicles but smooths out and packs much more quickly than does the untreated clay; there appears to be a more uniform vertical distribution of moisture in the treated soil, and a reduced moisture content at the bottom of the treated section. Maintenance is therefore more easily accomplished on the treated portion because there is no formation of the hard crust on the top before the road is sufficiently dry to drag, such as is characteristic of the untreated clays. No marked difference appears in the results brought about by the different depths of incorporation, and this is of some importance since it so directly affects cost of treatment. The laboratory tests of the heavy clays indicated a slight retardation of surface evaporation on the treated samples, but this fact seems to have no practical significance. Some two months after the Hallsville experiment was begun, it was observed that there was no development of ruts in the treated portion of the road following heavy rains while the untreated portion showed ruts from two to four inches in depth. Furthermore, the maintenance of the treated stretch of road seemed to be much more easily accomplished than that of the untreated part, mostly due to the fact that it could be begun much more promptly after the rains ceased.

Two other important test roads were established; one during September, 1924, in the Missouri River bottom lands near Jefferson City where the native soil is known as a Wabash Clay. This was divided into two sections of 500 feet each, treated with five per cent hydrated lime, one section to a depth of two and the other a depth of six inches. A second stretch of four hundred feet was established about November 1st, at Matney near St. Joseph, Mo., on a heavy blue clay with five per cent of lime to a depth of six inches. On March 1st, after the winter season, the Jefferson City test road was found to be in an excellent condition as compared with the untreated portions particularly in the matter of freedom from ruts. This was especially satisfactory considering the trying weather of the winter season. The advantageous results of lime treatment, however, were not so apparent on the St. Joseph road so early in the season. This was in some degree due to the fact that treatment took place late in the fall and the road was not thoroughly consolidated when freezing occurred. The ice cap which formed in December persisted for some weeks, and when the break-up came there was a considerable development for a short time. However, the traffic soon compacted the roadway, and since that time the treated section has shown a marked advantage in comparison with the adjacent portion of the normal clay. An inspection on April 11 showed it to be in good condition. The following tabulation offers in condensed form information relating to the various field tests sections:

| DATE of Trt'mt. | Location | Kind of Mat'l. | Length of Sec. Ft. | Depth of Trt'mt. | % Wt. Hyd. Lime | Cost per 100 Ft. |
|---|---|---|---|---|---|---|
| 1924 | Hallsville Road. | | | | | |
| 7-10 | Section 1 | Clay | 250 | 5-in. | 2 | $19.15 |
| 7-10 | Section 2 | Clay | 250 | 5-in. | 5 | 36.75 |
| 9- 1 | Section 3 | Clay | 250 | 2-in. | 5 | 15.13 |
| | Jefferson City Road. | | | | | |
| 9-15 | Section 1 | Wabash | 500 | 2-in. | 5 | 16.05 |
| | Section 2 | Clay | 500 | 6-in. | 5 | 38.26 |
| 11- 1 | St. Jos. Rd. | Clay | 400 | 6-in. | 5 | 48.86 |

In all cases, except the last, the width of the roadway treated was fourteen feet. The St. Joseph stretch was twenty feet wide but the cost indicated above is, for purposes of comparison, computed on the basis of fourteen feet width. The results of the investigation to date from the practical view-point seem to be encouraging although the effect of a long period of time on the stability of the mixtures is yet to be determined. So far, the changing moisture content, due to alternate wetting and drying, the wide ranges in temperature and the action of traffic have not destroyed the favorable effects of the lime, but it is deemed wise to extend the observations over a longer period of time.

Only negative results may be reported, however, in relation to the fundamental physical phenomena investigated; in the words of Mr. Wood, —"the tests . . . do not explain the basic action which results from the lime admixture." These facts are apparently established, however, the specific gravity of the soil is only slightly reduced by adding hydrated lime; the moisture-holding capacity and moisture equivalent are reduced in heavy clays; the rate of evaporation is slightly retarded; but there is more rapid capillary movement of the moisture after treatment; the voids in the soil become enlarged allowing an increased rate of percolation; and the bearing power at the higher moisture content is increased. We cannot, however, at this time offer a scientific explanation of these phenomena. It will no doubt need the co-operative efforts of the engineer, the physicist, the geologist and the colloidal chemist to lay bare the whole story of cause and effect.

## The Clark Bridge Type Dipper Front

THE Clark Bridge Type dipper front is a very rugged front with the bottom having a double wall supported by connecting ribs, which in turn form sockets for teeth, thus doubling the strength of the dipper lip. The ribs are so arranged that the front may be equipped with the number of teeth that will give the most efficient digging results. For example a 2½ yard front has nine sockets, and the operator may use either 3, 4, 5 or 9 teeth, depending on the kind of material to be dug and the particular features of the operation.

The construction just described results in a cutting edge arranged with a number of square tooth-pockets into which are placed, alternately, digging teeth made of square tool steel bars and pick-up teeth made of Amsco cast manganese steel. There is also provided under the teeth a small renewable wearing band on the outside of the cutting edge.

The number and length of the tool steel digging teeth may be readily changed according to conditions and they are quickly removed and resharpened since no bolts or other locking devices are necessary. This feature is of particular advantage on digging jobs which require sharp chisel-point teeth to obtain the requisite yardage. After the teeth become worn they may be brought forward by placing small blocks in the bottoms of the pockets holding the teeth, thus giving them the desired digging length. When the teeth are placed in the sockets they are always in the same plane thus allowing an even distribution of shock and wear over all the teeth.

The front is made perfectly flat and has the ability of making a smooth even cut which is so desirable in stripping or digging coal with power shovels, or digging slag. This flat bottom is so re-inforced that buckling is impossible, and the digging edge is very strong due to having an integral inside and outside wall joined together to numerous braces, forming as the name implies, the Clarke Bridge Type Front.

In addition to the features peculiar to the design of this new front, metal of which it is made is Amsco manganese steel which, as has been thoroughly proved, gives greater resistance to shock and wear than any other material thus employed. Used on the Amsco Missabe dipper, the Clarke Bridge type front has all the advantages that have made this dipper famous in hundreds of operations added to its own features and the sturdiness and durability of manganese steel.

# New Improvements on the Clyde Hoist Attachment for Fordsons

THE illustration below shows the new style Clyde hoist attachment for Fordsons. This hoist is of exceptionally sturdy construction and attached in such a manner that makes it as substantial as the Fordson itself.

The hoist frame is fastened to the tractor by eight of the bolts which connect the rear axle housing and the transmission housing and three bolts through holes in the drawbar cap. It is further held rigidly in place by guy rods which extend from the sides of the frame and securely attached to the rear axle housing. The hoist frame is equipped with a drawbar lug so that the tractor may be used for hauling purposes without removing the hoist or any part of it.

A winch head can be placed on all sizes of hoists built, the size of which is large enough to be used for auxiliary work and so attached to allow ample room between it and the rear wheel of the tractor.

The power is applied through a roller chain drive and sprokets from the pulley shaft of the Fordson. The pulley is removed and a sproket installed in its place. A rod placed on the lever side of the hoist gives the operator full control of the throttle from his regular position. The drum is friction driven and equipped with a ratchet with a pawl, asbestos-lined brake band which is foot lever operated. This lever is placed in a position for convenient operation. The hand lever is made of forged steel.

The drum bushings are grease cup lubricated. All shaft bearings are babbitted and lubricated with grease cups, the drum shaft bearings being equipped with removable caps.

Three sizes of this hoist are built—No. 4001 with a line pull of 4000 lbs. at 175 f. p. m., No. 4002 with a line pull of 4700 lbs. at 150 f. p. m., and No. 4003 with a line pull of 5600 lbs. at 125 f. p. m. The drum barrel has a capacity of 600 ft. of ½-in. cable.

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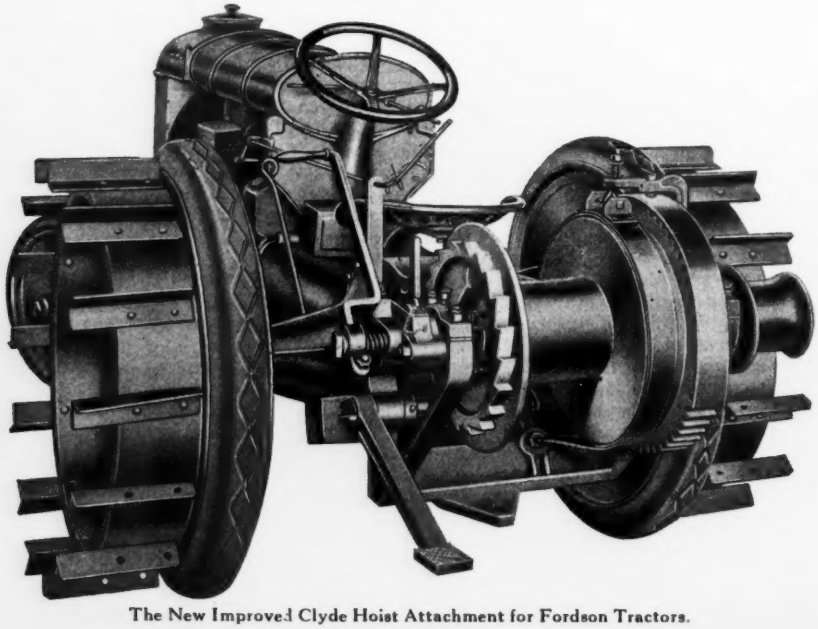
Mr. G. R. Lyman, General Sales Manager of the Taylor-Wharton Iron & Steel Company, resigned effective May first. Mr. G. R. Hanks, formerly Superintendent of the High Bridge plant of this company, has been appointed Assistant to the President with full charge of all sales. Mr. Stanley Apgar has been appointed Plant Superintendent.



The New Improved Clyde Hoist Attachment for Fordson Tractors.

# New P & H Excavator

THE P & H family of excavators has recently been enlarged by the development of a new ½ yard, full revolving, gasoline or electric machine, mounted on Corduroy Traction and known as Model 204.

This new machine, which is designed and built by the Harnischfeger Corporation, Milwaukee, Wisconsin, resembles the other P & H models in that it involves the same general principles of construction and operation as has long been recognized as a standard in the gasoline driven excavator field.

The power is supplied by a single gasoline motor, of the heavy duty, tractor type, developing 40 H. P. at 960 R. P. M. All power is transmitted through cut steel gears with the minimum number of reductions. The two main drums are independently mounted on separate shafts and are controlled by outside band clutches and brakes, the clutches being operated by Power Clutch Control. The drums have a standard line speed of 110 ft. per min., but may be lagged to give higher speeds for certain work. Both the revolving frame and car body frame are of cast steel, in one piece. All shafts are turned and ground to micrometer size and all bearings are provided with Alemite or pressure cup lubrication. The Corduroy frames are heavy steel castings, which receive the weight of the machine from two heavy forged axles. The treads are non-cloggable and the tread rollers are swiveled in two directions to adjust to any irregularities of the ground. All gears are well guarded to protect the operator and the first reduction and travel gears are fully enclosed, running in oil. There are two travel speeds—1⅛ and 1⅜ M. P. H.—forward and reverse. All steering is controlled from the operator's platform by use of a simple hand wheel. The main machinery and operator's platform are fully enclosed in an all-steel cab, provided with suitable doors and windows for care and operation.

This machine handles a ½ yd. dragline or clamshell bucket on a 30 ft. boom and has a rated lifting capacity of 13,000 lbs. at 10 ft. radius, which is 75% of its tipping capacity. The shovel is ½ yd. capacity and of the standard P & H design, with an all-steel, box section boom, outside dipper sticks and a crowding motion which enables the operator to have full control of the dipper at all points, acting independently from the hoisting motion.

This machine meets a distinct need for a light weight, sturdy, fast, powerful and durable machine possessing great mobility and ease of control.

# A Ball Bearing Spur Gear Reducer

THE Albaugh-Dover Mfg. Company's spur gear reducer has a number of features that are novel, that are also improvements over the usual transmission of the enclosed type in which the driving shaft, which is usually the motor the driven shaft, which is usually connected to the unit to be driven, projects through the opposite side.

All shafts are on ball bearings and the housing is oil tight with full and clear space inside without any obstructions such as partitions for supporting countershafts or gears on stationary or revolving discs with overhung pins, etc. It is usually comprised of three counter-shafts uniformly spaced about the center line of drive shafts which carries the change speed gears between the driving and the driven shafts. The three countershafts extend extirely across the length of the reducer housing between the end walls and are journaled in the end walls of the casing on their ball bearings.

The transmission gears are of high grade material to minimize the size and reduce the total weight of the entire unit. Only one set of shafts is required for single, double or triple sets of reduction gears for the largest ratios of speed reductions usually required in one unit, making a minimum number of parts and all self-contained with equal distribution of transmission load from the driving to the driven shafts, all self-oiled from the same reservoir of oil in the full size bottom of the usually circular gear housing.

Extreme reduction is attained with maximum power in the transmission by having a revolving internal gear meshing with pinions on the projected ends of the countershafts outside of the main housing. The internal gear together with the shaft couplings connected to the driving and the driven ends of the shafts are enclosed by attached housing extensions which are both safety covers and protection to the gears and bearings from dust as well as providing a covering for safety. These features are exclusive and new in these gear reducers.

There is no loss in efficiency due to the usual multiplicity of bearings and bearing surfaces, there being no inside bearings that may become oil clogged, run dry, etc., by inability to inspect. All the parts are large, plain and sufficiently powerful to transmit the load specified with ample safety. All parts are of standard design and construction, made as durable as modern methods and materials can provide that they may be quickly and easily replaced in emergency.

Any ratio desired of speed change between driving motor and driven machine may be affected within the limits of gear ratios, with either increased or decreased final drive speed to meet transmission requirements on the final drive. There are no overhung pins on overhung internal gears, no stationary or revolving disc supports, no stationary nor revolving internal gears within the reducer housing.

It is claimed that these reducers may be run to the right hand or left hand with equal facility by reversing the direction of driving motor and will provide equal results in the transmission of power running constantly in the same direction or alternately reversing. The drive shaft and the driven shaft always revolve in the same direction of rotation with any ratio of reduction.

These reducers are furnished for direct connected shaft drives to conveyors or elevators in place of the chain or belt types, and are located between the motor and the driven unit occupying a minimum of space and eliminating excessive supports as for exposed transmission shafting, pulleys, sprockets, chains, etc., etc. and eliminating the excessive outside erection labor by substituting the installation of the spur gear reducer fitted complete in the gear factory and shipped ready to set in place.

The Albaugh-Dover Mfg. Company furnish these units for any capacity and ratios within the limits that govern gear teeth ratios, and for durability and low cost in service are not to be compared with any other speed reducer on friction bearings with their possibilities of misalignment, cutting, heating, etc. There are no multiplicity of shafts overlapping each other with duplicate sets of friction bearings within the housing.

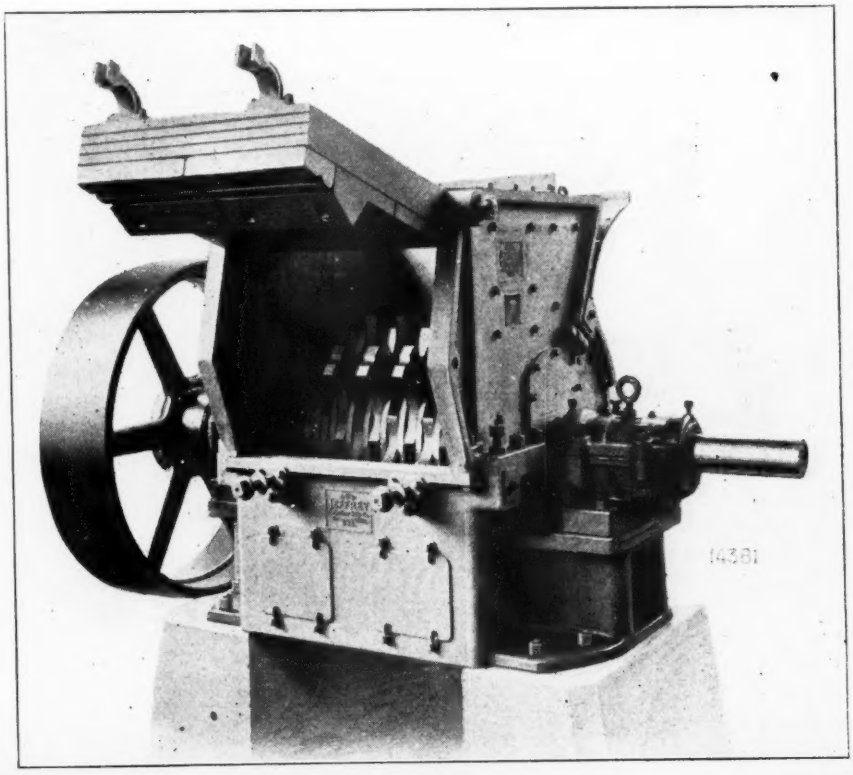
# The Jeffrey Rigid Hammer Crusher

THE Jeffrey Rigid Hammer Crusher a new type machine designed especially to reduce in one operation run-of-mine coal to a uniform product consisting of smaller sized pieces with a less amount of fines than has heretofore been practical with coal crushers. Other types of crushers have been successful for producing uniformly sized material from 1¼-in. mesh upwards, but for a smaller uniformly sized product it has been necessary to screen out and re-pass through the crusher oversized pieces until the desired result is obtained. This naturally cuts down the capacity, and, at the same time adds the expense of additional equipment.

The problem confronting Jeffrey engineers has been to build a crusher which will produce a small uniformly sized product in a single operation with the minimum of fines. Such a smaller sized product is required for chain grate stokers, for preliminary reduction in pulverized fuel plants, and is also often desirable for preparing inferior fuels for clean and quick combustion.

The problem is solved in the new Jeffrey Rigid Hammer Crusher which receives run-of-mine coal and crushes it in one operation to uniformly sized pieces of any desired size. In a test under actual plant operating conditions a 42x36 Rigid Hammer Crusher consumed only ⅓ Horse Power per ton per hour when crushing at the rate of 100 tons per hour. The product from the same test showed:

| | |
|---|---|
| 99% through | ¾-in. Mesh Screen |
| 86% through | ½-in. Mesh Screen |
| 67% through | ⅜-in. Mesh Screen |
| 44% through | ¼-in. Mesh Screen |
| 30% through | 6-Mesh Screen |
| 21% through | 10-Mesh Screen |
| 11% through | 20-Mesh Screen |



The Jeffrey Rigid Hammer Crusher.

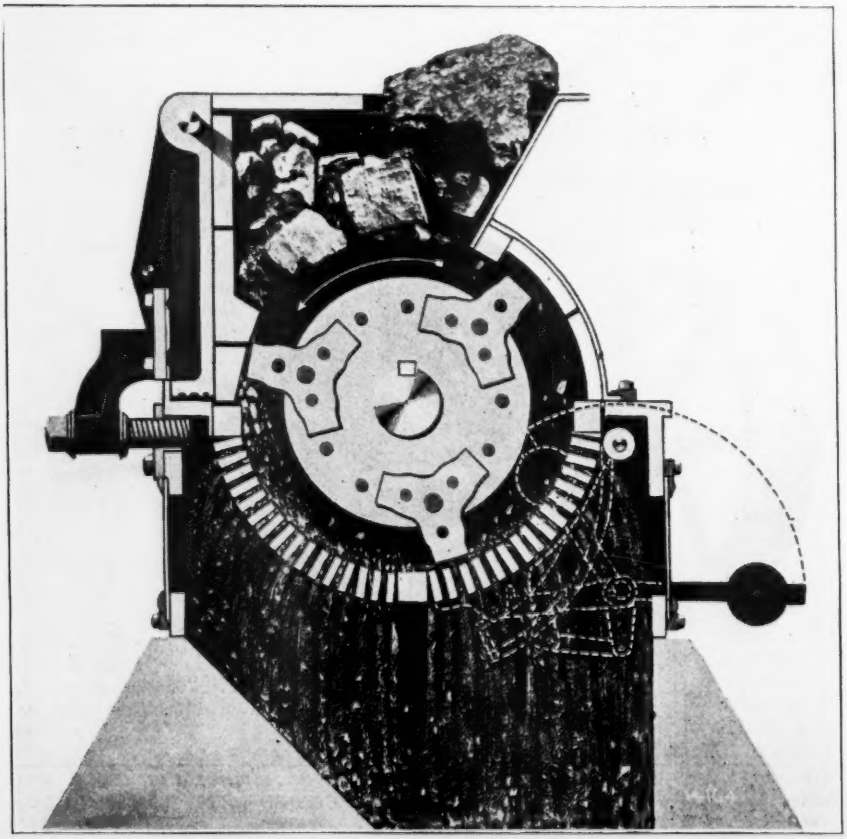
With an assortment of machine sizes and by adjustments within each size, a complete range of capacities and products from a few tons to hundreds of tons per hour is available. The adjustments are made in the breaker plate or screen bar spacing, also by regulating the speed of the crusher rotor. The same adjustments make it possible to produce large or small pieces with any one of the machine sizes. In the test related above the screen bars spaced ¾-in. apart and the rotor was running 220 revolutions per minute.

The Jeffrey Rigid Hammer Crusher will work satisfactorily on all grades of coal, and after preliminary adjustments to make the desired product, only the minimum of care and attention is required.

The construction is heavy throughout and all wearing parts are renewable, including inside frame liners and the breaker plate. The rotor consists of an extra heavy shaft on which steel discs and steel through rods holding the crushing teeth are mounted The heavy manganese teeth have six wearing corners which are brought into service by simply turning a fresh corner to the work side. The general appearance and arrangement of the crusher teeth is shown in figure 1.

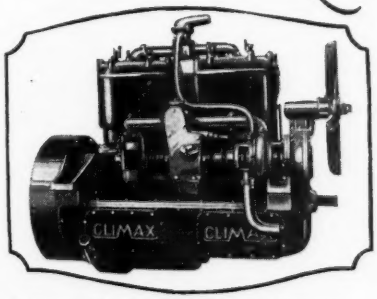
The lined breaker plate which forms one end of the upper frame is hinged providing easy access to the crusher rotor. An adjusting screw, shown on photo No. 1, regulates the space between the breaker plate and the crusher teeth. A drop bottom screen frame illustrated in the same photo operated through weight levers is available for the release of overloads, for removing tramp iron, or other foreign material.

A heavy flywheel type drive pulley adds momentum to the rotor but is affixed to the shaft by a breaking pin connection which protects the working parts from damage should obstruction get into the machine.



Sectional View of Jeffrey Rigid Hammer Crusher

*Bay City 16-B Crane excavator equipped with Climax "Trustworthy" Engines at work widening Dixie Highway near Pontiac, Mich. Job estimated to take 7 weeks. Finished in 4 weeks.*

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Russell Co., Massillon, Ohio
Vulcan Iron Works, Wilkes-Barre, Pa.
Geo. D. Whitcomb Co., Rochelle, Ill.
Wisconsin Farm Tractor Co., Sauk City, Wis.
W. T. Young Engine Co., Oil City, Pa.

# FOR SALE OR RENT

### STEAM SHOVELS

1—Type "B" Erie Combination Steam Shovel and Crane. Shop No. 2050. New in 1922. Caterpillars. Standard shovel boom with ¾-yd. dipper, 36-ft. crane boom, bucket operating drums and ¾-yd. clam shell.
1—Erie B. Shop Nos. 143, and 1219, traction wheels, ¾-yd. dipper.
1—Type O Thew, Shop No. 1777, extra high lift, ⅝-yd. dipper, traction wheels.
1—18B Bucyrus, Shop No. 1870, traction wheels ⅞-yd. dipper.
2—70-C Bucyrus, Shop Nos. 1195 and 1197, 2½-yd. dippers.
3—70-ton Bucyrus Shop Nos. 939, 977 and 1233, 2½-yd. dippers.
2—60C Bucyrus, Shop Nos. 1286 and 1388, 2½-yd.
1—45-C Bucyrus. Shop No. 1202. Railroad type, 1¾-yd. dipper.
2—Model 60 Marion, Shop Nos. 1301 and 2238, 2½-yd. dippers.
1—Model 75 Marion, Shop No. 2112, 2½-yd. or 4-yd. dipper.
1—Model 80 Marion, Shop No. 1312, 4-yd.
1—95-C Bucyrus, Shop No. 1235, 4-yd. or 5-yd. dipper.

### STEAM SHOVEL PARTS

1—Boom for Marion 60 or 61 Shovel, length 35 ft., 22-ft. dipper arm, 1½-yd. dipper, long jack arms, etc.

### SIDE DUMP CARS

59—16-yd. Western Air Dump Cars.
31—12-yd. Western Air Dump Cars, 19-ft. beds, box girder doors.
11—12-yd. Western Air Dump Cars, 19-ft. beds, box girder doors, vertical dump cylinders, 60,000 lb. capacity trucks.
11—12-yd. Western Air Dump Cars, Truss-Rod Doors, 26-ft. beds.
4—12-yd. Oliver Hand Dump Cars.
12—8-yd. Western, 36-in. gauge, double truck cars.
7—5-yd. K. & J. 36-in. gauge Side Dump Cars, steel draw sills and steel lined wood beds.
24—4-yd. Western 36-in. Gauge Cars.
8—4-yd. Continental 36-in. Gauge Cars.

### SPREADER CARS

2—Std. gauge Western Spreader Cars.
1—36-in. gauge Oliver Spreader Car.
1—36-in. Western Spreader Car.

### LOCOMOTIVES—Standard Gauge

1—19x26 Baldwin 6-wheeled Switcher, with tender. Shop No. 48215. New 1918. Weight 62 tons. 180 lb. steam pressure.
1—19x24 Baldwin 6-wheeled Saddle Tank. Shop No. 49553, built 1918. Weight 67 tons, air brakes, 180 lbs. steam pressure.
1—18x24 Brooks 6-wheeled Switcher, with tender, Shop No. 1778. Wt., 50 tons.
1—17x24 Davenport 6-wheeled Switcher, with tender. Shop No. 1268. Steam pressure 180 lbs. Wt., 47 tons.
1—17x24 Schnectady 6-wheeled Switcher with tender. Shop No. 2956. Wt. 44 tons.
1—16x24 Porter 6-wheeled Saddle Tank, Shop No. 6065. Built 1918. Weight, 56 tons, 180 lb. steam pressure.
1—16x24 Vulcan 4-wheeled Switcher, with tender, Shop No. 1764. Steam pressure 180 lbs. Weight 40 tons.
2—16x24 Davenport 4-wheeled Switchers, with tenders. Shop Nos. 860 and 861. Steam pressure, 170 lbs. Wt., 38 tons.
1—13x18 American Saddle Tank. Shop No. 55248, built 1916. Wt. 32 tons.
1—11x16 Davenport 4-wheeled Saddle Tank Locomotive. Shop No. 1027. Wt. 20 tons. Steam brakes.

### 42-IN. GAUGE

1—11x16 Vulcan 4-wheel Saddle Tank. Shop No. 3085. Steel cab, A.S.M.E. boiler, 165 lb. pressure.

### 36-IN. GAUGE

2—11x16 Davenport Dinkies. Shop Nos. 2020 and 2027. New in 1925, used six weeks. Weight 21 tons.
1—11x16 Porter Dinkey, Shop No. 6717. New in 1922. Wt. 21 tons.
1—9x14 Vulcan Dinkey. Shop No. 1675. Weight 14 tons.

### 24-IN. GAUGE

3—7x12 Davenport Dinkies. Shop Nos. 1202, 1411 and 1524. Weight 9 tons.
1—7x12 Vulcan Dinkey. Shop No. 2345. Weight 9 tons.
1—6x10 Davenport Side Tank Dinkey. Shop No. 1307. Wt. 7 tons.

### DRAGLINE EXCAVATORS

3—Class 24 Bucyrus Steam, Shop Nos. 3445, 3500 and 3671, skids and rollers, 85-ft. to 100-ft. booms; 3½, 4½ or 5-yd. Page buckets.
1—Class 20 Bucyrus, steam. Shop No. 813, skids, 85-ft. boom, 3-yd. Page bucket.
2—Class 14 Bucyrus, steam. Shop Nos. 3387 and 748, caterpillars. 60-ft. booms, 2-yd. Page buckets.
1—Model 210 P & H, gasoline, Shop No. 1077, New 1920, 48-ft. boom, 1¼-yd. Page bucket, caterpillars.

### CRANES

1—Type "B" Erie Combination Crane and Steam Shovel. Shop No. 2050. New in 1922. Caterpillars. 36-ft. crane boom, bucket-operating drums, ¾-yd. clam shell; also standard steam shovel equipment with ¾-yd. dipper.
1—Type "B" Erie Crane, Shop No. 1219. 32-ft. boom, bucket-operating drums. ¾-yd. Williams clam shell.
1—10-ton Industrial, 4-wheeled. Shop No. 1989. 40-ft. boom, bucket operating.
1—20-ton McMyler, 8 wheeled, Shop No. 388, 45-ft. boom, 1¼-yd. O. & S. clam.
1—Gantry Crane. New in 1919; 48-ft. boom, 15-ton cap. at 18-ft. radius; 7-ft. 10½-in. gauge, 12-ft. wheelbase, self-propelling. Base of boom 17 ft. above track. Bucket-operating drums. Wt. 50 tons.

### MISCELLANEOUS

1—32-ft. Erie Crane Boom with Drum.
1—10-ton Austin Gasoline Road Roller.
1—8-ft. Austin Giant Road Grader.
1—6x10 D.C., D.D. Lidgerwood Hoist, with 36x90-in. boiler.
1—6½x10 D.C., D.D. American Hoist, with butt strapped boiler.
1—7x10 D.C., D.D. Lambert Hoist, without boiler.
1—7x10 D.C., D.D. Flory Hoist, without boiler.
1—¾-yd. Page Dragline Bucket.
2—1½-yd. Page Dragline Buckets.
1—1½-yd. Brown Hoist Clam Shell Bucket.
4—Mead-Morrison 1½-yd. Clam Shell Buckets.
2—1¼-yd. O. & S. Coal Loading Clam Shell Buckets.
1—100-hp. Nagel Boiler, A.S.M.E., 125-lb. steam pressure.

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### LOCOMOTIVES

6—Porter standard gauge saddle tank cylinders 14 x 22, weight 42 tons, new last year. Shop Nos. 6768, 6769, 6770, 6771, 6772, 6773.

6—Porter 36 inch gauge saddle tank 10 x 16 cylinders, weight 18 tons, new last year. Shop Nos. 4619, 4667, 6804, 6805, 6883, 6884.

1—Davenport, standard gauge, saddle tank cylinders 10 x 16, weight 20 tons. Shop No. 1497.

### STEAM SHOVELS

1—Bucyrus 50B on caterpillars 1¾ yard dipper, 26 ft. boom, 17 ft. dipper stick, new last year. Shop No. 4047.

2—Bucyrus 78C 3 yard rock dipper, 30 ft. boom, 19 ft. dipper stick, 1 on caterpillars, 1 on R. R. trucks, new last year. Shop Nos. 3995, 4124.

### DRILLS

4—Keystone, well drills, sizes 3½ and 5½.

23—Ingersoll-Rand Jackhammers.

5—Ingersoll-Rand Calyx drills—2 with pumps.

3—Tripod Drills—2 I-R, 1 Sullivan.

8—Waugh Denver Rock Drills—Model 31.

6—Waugh Denver Rock Drills—Model 21.

### COMPLETE CRUSHER PLANT

Consisting of—1 size 7½, 1 size 5 Austin crushers, 2 Elevators with extra buckets, links and sprocket—1 double Rotary Screen, 65 H. P. Engine, 125 H. P. boiler, air compressor—4, 2 yd. steel cars— 1, 8 x 10 and 1, 5 x 7 Hoists. Capacity 500 cu. yds. per day.

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Large stock of gasoline locomotives for narrow gauge. Steam, gasoline and electric hoists. Derricks, stiff leg and guy.

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**If you don't see listed what you want, write us. We may have it.**

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# ELECTRIC MOTORS

## *for Quarries and Pits—*

***Send for our Monthly Bargain Sheet and get our prices.***
***This is only a partial list.***

**THREE-PHASE, 60 CYCLE MOTORS, 220 OR 440 VOLTS**

| Qu. | H.P. | | Speed |
|---|---|---|---|
| 1 | 35 | G. E., form K, to American, single stage centrifugal pump | 870 |
| 1 | 35 | G. E., form K | 720 |
| 1 | 40 | Westinghouse, type CW, slip ring | 1160 |
| 1 | 40 | Wagner, type BP | 1140 |
| 1 | 40 | Westinghouse, type CS | 870 |
| 1 | 40 | Westinghouse, type CS | 695 |
| 1 | 40 | Westinghouse, MW, slip ring | 850 |
| 5 | 40 | Westinghouse, CX | 580 |
| 1 | 50 | Fairbanks-Morse, type BV slip ring | 1200 |
| 1 | 50 | Allis-Chalmers, type AN | 1160 |
| 1 | 50 | G. E., type I, form M, slip ring | 700 |
| 1 | 50 | Westinghouse, type CS | 870 |
| 1 | 50 | Allis-Chalmers, type AN | 850 |
| 1 | 50 | Westinghouse, HF, slip ring | 680 |
| 1 | 75 | G. E., form K, 2300 v. | 1800 |
| 2 | 75 | G. E., type I, form M, slip ring | 860 |
| 1 | 75 | G. E., form K | 600 |
| 1 | 75 | Westinghouse, type CW, slip ring | 435 |
| 1 | 100 | Westinghouse, type CS | 870 |
| 1 | 100 | Allis-Chalmers, slip ring, 2200 v. | 865 |
| 1 | 100 | Westinghouse, type CW, slip ring | 865 |
| 2 | 100 | Westinghouse, type CW, slip ring | 350 |
| 1 | 125 | Fairbanks-Morse | 900 |
| 1 | 150 | Allis-Chalmers, 2200 v. | 580 |
| 1 | 250 | Westinghouse, type C | 850 |
| 1 | 250 | Fairbanks-Morse, type HV ball bearing, slip ring | 600 |
| 2 | 250 | G. E., type I, form M, slip ring | 385 |
| 1 | 300 | G. E., type I, form M, slip ring | 1200 |

**THREE-PHASE, 25 CYCLE MOTORS, 220 OR 440 VOLTS**

| Qu. | H.P. | | Speed |
|---|---|---|---|
| 1 | 10 | G. E., form M, slip-ring | 750 |
| 1 | 10 | Westinghouse, type HF, slip ring | 715 |
| 3 | 10 | G. E., type I, form M, slip ring | 750 |
| 4 | 10 | Wagner, type BP, new | 750 |
| 1 | 15 | Watson, type KH | 720 |
| 1 | 20 | Fairbanks-Morse, type B | 750 |
| 2 | 20 | Wagner, type BM | 710 |
| 4 | 20 | G. E., form K | 750 |
| 1 | 25 | G. E., form K | 750 |
| 1 | 30 | Fairbanks-Morse | 750 |
| 1 | 30 | Allis-Chalmers, AN | 720 |
| 2 | 35 | G. E., type I, form K | 750 |
| 1 | 35 | G. E., type I, form M, slip ring | 750 |
| 1 | 37 | G. E., MTC, hoist motors | 750 |
| 1 | 40 | G. E., form K | 1500 |
| 1 | 40 | G. E., form K | 750 |
| 1 | 40 | Allis-Chalmers, AN | 750 |
| 1 | 50 | G. E., form K | 1500 |
| 2 | 50 | Allis-Chalmers, type AN | 750 |
| 1 | 50 | Fairbanks-Morse, type B | 750 |
| 1 | 50 | G. E., type I, form M, slip ring | 750 |
| 1 | 60 | Allis-Chalmers, type AN | 720 |
| 2 | 60 | G. E., form K | 720 |
| 1 | 75 | Westinghouse, CI, hoist, motors | 500 |
| 1 | 100 | Westinghouse, CW, slip ring | 750 |
| 1 | 100 | G. E., type I, form M slip ring | 750 |
| 1 | 100 | Wagner, type BR, slip ring | 710 |
| 1 | 112 | G. E., ITC, form M, slip ring | 710 |
| 1 | 125 | G. E., form K | 500 |
| 1 | 150 | G. E., type I, form M slip ring | 750 |
| 1 | 150 | Allis-Chalmers, type ANY, slip ring | 750 |
| 1 | 200 | Burke, 440 v. | 500 |

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1— 396-ft. Class WB-2 Sullivan, 2 stage.
1— 558-ft. Norwalk 2 stage.
1— 558-ft. Class WB-2 Sullivan, 2 stage.
1— 628-ft. Class A Ingersoll-Sergeant.
2— 734-ft. Imperial X-2 Ingersoll-Rand.
1—1056-ft. Imperial X-3 Ingersoll-Rand.
1—2394-ft. Imperial X-3 Corliss Ingersoll-Rand.

The above all designed and built for 100 to 150 lb. steam pressure and to deliver air at 80 to 120 lb.

1—16x16x14 XB-1 Imperial Ingersoll-Rand belt driven compressor, built for 30 lb. terminal air pressure. Capacity 1000 ft.

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1—Wm. A. Box Iron Works Company Electric Hoister, No. 80-16688. Rope Speed 700 ft., P.M. Pull 5500 lb., double drums 42x29 in. Complete with 112-hp. G.E. motor, 3 ph., 60 cy., 440 v., 690 r.p.m. (This equipment practically new.)

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1—14x36 L. H. Murray Corliss.

**All guaranteed first class**

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# FOR SALE OR RENT

## STEAM SHOVELS

1—Model 29 Osgood. Standard revolving. Shop No. 1117, mounted on all steel tread caterpillars, 20-ft. boom, 16-ft. dipper handle, 1-yd. dipper.

1—70-C Bucyrus. Shop No. 1749. Standard gauge, railroad, 2½-yd. dipper.

1—18B Bucyrus, revolving. Shop No. 1764. Traction wheels, ⅞-yd. dipper.

1—Type B Erie Revolving Steam Shovel, traction wheels, standard boom, ¾-yd. dipper.

1—Model 212 Marion (revolving). Shop No. 4620, New Sept. 1923, mounted on trucks, 55-ft. boom, 34-ft. dipper stick, 1¾-yd. dipper.

1—Model 28 Marion, standard revolving. Shop No. 2804, traction wheels, ⅝-yd. dipper.

1—Little Giant Railway type, standard gauge, equipped with standard boom, 1¼-yd. dipper.

## CRANE

1—Northwest, Model 105, gasoline, standard caterpillar, 40-ft. boom, bucket handling.

## TRACTORS

3—10-ton Holt Caterpillars.

7—5-ton Holt Caterpillars. (These tractors have never been used except for demonstrating purposes.)

## CYCLONE DRILLS

2—No. 14 Junior Gasoline Traction Big Blast Hole Drills. 5-in. bits. Late machines.

## DRAGLINES

1—Class 210 P & H Gasoline. No. 1349, on caterpillars. 76-hp. Twin City Engine. 48-ft. boom, 1¼-yd. bucket.

### DRAGLINES—Cont.

1—Class 14 Bucyrus, steam operated, on caterpillars, 60-ft. boom, 2-yd. Page bucket. (New July, 1922).

1—Class 24 Bucyrus, steam operated, skids and rollers, 100-ft. boom, 3½-yd. bucket.

1—Monighan 2-T Walker. Oil driven, 60-ft. boom. 2 cu. yd. bucket.

1—No. 2 Monighan, steam operated, skids and rollers, 70-ft. boom, 2-yd. bucket.

1—No. 2 Monighan, steam operated, skids and rollers, 80-ft. boom, 2-yd. bucket.

1—Page oil driven, mounted on trucks, 100-hp. twin cylinder, Charter Engine, 72-ft. boom, 2½-yd. Page bucket.

## MISCELLANEOUS

1—¾-yd. dipper for Model 18 Osgood Shovel.

1—2-yd. Hayward Orange Peel Bucket.

1—3-yd. Hayward Orange Peel Bucket.

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**22—Standard Gauge 6 yd. capacity 2 way Dump Cars, Rebuilt with New Bodies, etc.**

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**1—Marion "21" on caterpillars, ¾ yd., with clam-shell and Dragline attachment: Used only 60 days since built, Overhauled.**

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**(Est. 1889)**

**ATLANTA, GA.**

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1—TYPE B ERIE, Steam Crawler Crane, Shop No. 2600, new 1923, ALL STEEL CATERPILLARS, 40 ft. boom, bucket operating; used six months.

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This machinery, used about sixty days, has been well cared for, and is as good as new.

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BROWNING, standard gauge, eight wheels, double drums, 46′ boom, one yard bucket, used about seven months and in A-1 condition. Rare bargain and better wire us if interested.

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McMyler 25 ton 50′-70′ Boom.
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Three 9"x15", One 10"x20", Two 12"x24", One 15"x30", One 18"x36", One 24"x36", and One 36"x42" Jaw Crushers.

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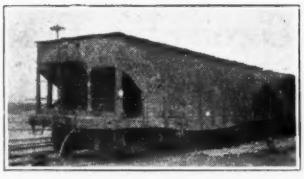

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Railway Type, Mang. Dippers
Crushers, #10, 9, 8, 7½, 6, 5, 4, 3

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**84x72, 36x60, 54x24, 18x30**

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22x52", 12x20", 12x26", 20x24", 15x36"
DISC CRUSHERS, 48", 36", 24", 18"
120 H.P. Gasoline Engine
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New 78x20 and 78x25 Screens and others.

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500—Pneumatic Drills, Riveters and Chippers
7—Grinders (Emery and Tool)
100—Motors (25 and 60 cycle)

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Dept. 61
JOPLIN, MO.

## NEW ROLLER CHAIN
at
## BARGAIN PRICES

15,000 feet Link Belt Chain. Their specification No. R. C. 126.

21,000 feet Whitney Mfg. Co.'s chain, their specification No. 471.

Size 1¼" Pitch, ⅝" Width, ⅝" Diameter. 13,000 lbs. Av., Ult. Strength.

Will furnish in any quantity

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110 S. DEARBORN ST., CHICAGO, ILL.

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1—No. 4, 6 cylinder Kritzer Hydrator, Capacity 5 tons crushed lime per hour. In good condition. Very reasonable terms. For further particulars address

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## FOR SALE

1—Lawson Automatic Loop Tramway, 1170 feet. New.
1—No. 4 Six Cylinder Kritzer Lime Hydrator.

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Draglines—Bucyrus, class 24 and 16.
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1—18x16 Single Roll Crusher—Pennsylvania, McLanahan, or other good make, with or without elevator. Quote price, location and full description. Address Box 60, Pit and Quarry, 538 S. Clark St., Chicago.

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1—P & H 206 gasoline crane, full caterpillar, ¾ yd. clam shell bucket. Can furnish standard shovel attachment with ¾ yd. dipper for same. Can also be arranged for dragline.
1—Thew gasoline shovel, full caterpillar, ¾ yd. dipper, high lift type.

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One Model 75 Bucyrus Railroad Type Steam Shovel, 2½ yard dipper, in first class condition. $3500.00 f. o. b. New Ulm, Minnesota.
One large friction type car puller with 25 H. P., 220 volt motor and belt.

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Nine ton, Model "C" MINSTER, never been used. Can be inspected at our works at any time. 36" gauge. Buda Motor. Price F.O.B. our works, $2,750.00, subject to prior sale.

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1—200 H.P. Gas Producer.
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A Complete Power Plant
*NEW—A BARGAIN*

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2—Symons Disc Crushers, type C, size 36", with or without a quantity of new parts. In excellent condition ready for service. Have been replaced with 48" size.

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2—200 HP Dry Back Scotch Marine type, excellent, 140 lb. steam.
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450 ft. Ingersoll Belted Air Compressor.
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One Acme 7-A Crusher. Must be in good condition.

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FOR SALE AT SECOND-HAND PRICE
A new Buchanan all steel sectional jaw crusher with manganese steel jaws, cheek plates and toggle bearings.

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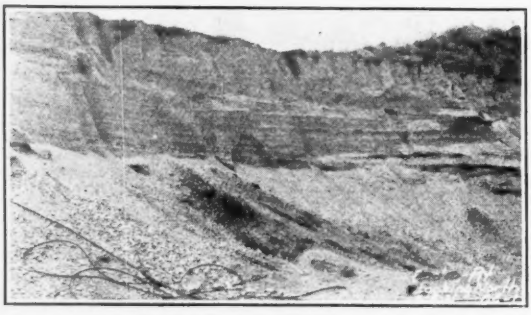
# A GOLD MINE CHEAP!

(82 Acres of Gravel)



This piece (107 acres) 82 of which is gravel with 12 feet of plaster rock underneath makes an ideal pit. Plaster rock can be mined all winter—gravel all summer—making all year proposition.

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No longer is it necessary to have a lot of expensive teams or unreliable labor. One man with a Miami Fordson (one man) Power Scraper will remove all the overburden from the average pit or quarry. One hundred yards every ten hours in a two hundred foot haul is a small day's work.

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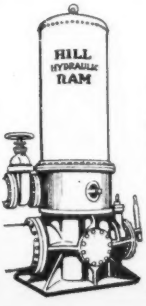


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Made in 12 sizes
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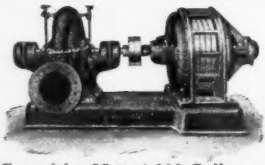

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Capacities 25 to 4,000 Gallons per minute.

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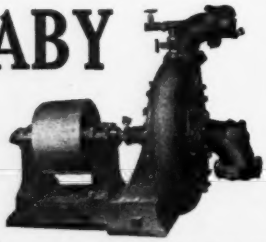

Illustration shows belted outfit but can also be supplied direct connected to Vertical Engine upon same base.

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Testing fire clay, limestone and other mineral lands, using double core barrels.

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WE DRILL FOR FIRE CLAY, LIMESTONE, SOAPSTONE, GYPSUM, ROCK SALT AND ALL OTHER MINERALS USING DIAMOND CORE DRILLS

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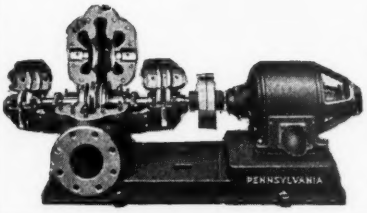


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These extremely rigid crushers have been designed for crushing hard rock and gravel to the small sizes required for road surfacing and reinforced concrete construction. They are built in in sizes corresponding to the Austin Standard No. 3, No. 4 and No. 5 crushers.

Write today for a copy of the special bulletin describing Austin Super Crushers in detail.

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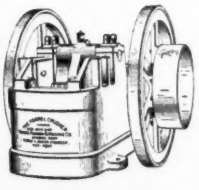

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Thousands in use on the hardest rock. Built in all sizes, 6″x3″ to 60″x48″. Complete rock crushing plants designed and equipped, also sand and gravel, washing and screening plants.
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Engineers and Manufacturers
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YORK Kiln · SCHULTHESS Hydrators · YORK Double Shell Dryers

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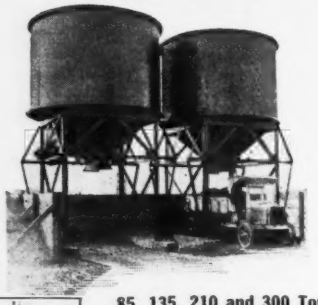

85, 135, 210 and 300 Ton Capacities.

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Equipped with a no-jam gate.

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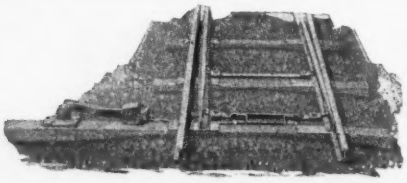

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The derailing of industrial cars or locomotives during the busy season means serious inconvenience and loss of time. You can avoid this by putting in Helmick Improved Switches and Frogs. They spell safety and service.

Helmick complete track equipment is described in our catalogue. Send for a copy today

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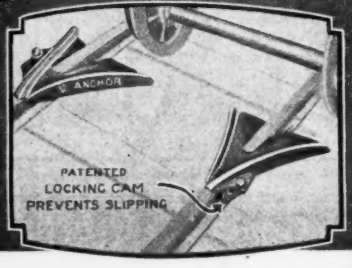


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Why?

Because they pay for themselves in a week by the time they save you.

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PRODUCE
Quicker Swings
More Work
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The experience of use has proven them—That's why they are so universally used on bull wheel derricks.

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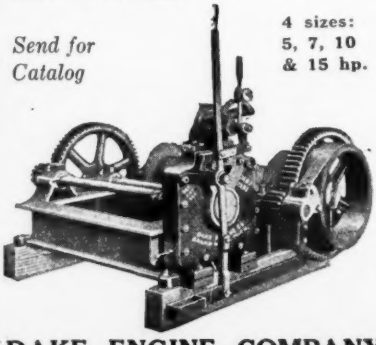

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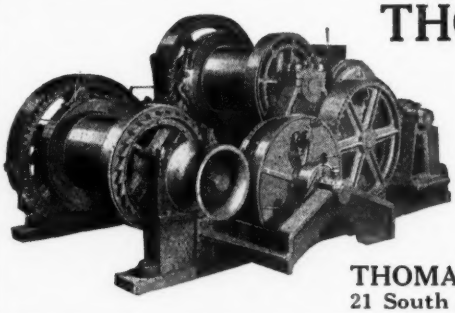

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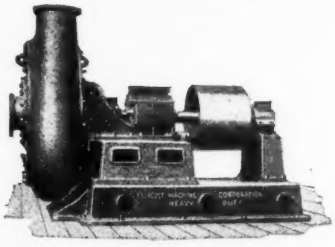

Fig. 334—Heavy Duty Dredge Pump
*Send for Bulletin 2521*

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**Baltimore, Maryland, U. S. A.**

HYDRAULIC DREDGES

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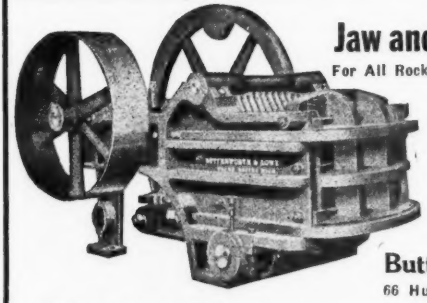
SAND AND GRAVEL PUMPS



Nippers—17x19", 18x26", 20x30", 24x36" and 26x42"

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We design modern Plaster Mills and make all necessary Machinery, including Kettles, Nippers, Crackers, Buhrs, Screens, Elevators, Shafting, etc.

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**Butterworth & Lowe**

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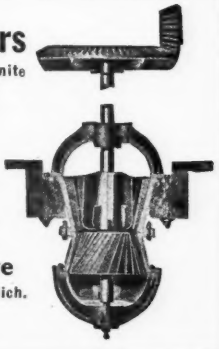

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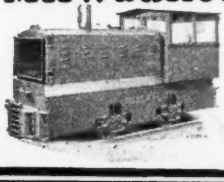

BUILT in sizes from four to fifteen tons. For all Gauges of Track. There's a size for every purpose.

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MILWAUKEE LOCOMOTIVE MFG. CO. MILWAUKEE WISCONSIN

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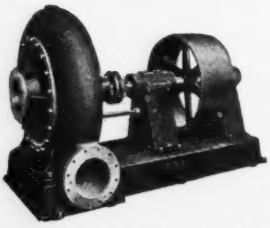
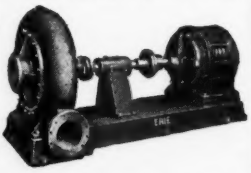


There is an especially designed ERIE for each pumping need,—for sand, gravel, material washing, water supply etc.

Owners, engineers and operators of ERIE equipped plants everywhere, testify to the satisfactory performance given by ERIE pumps. The ERIE is all you want a pump to be. More than half of our dredge pump business comes from customers of more than eight to ten years standing.



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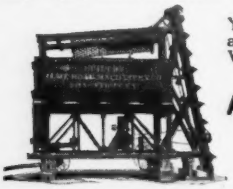
Whether you need a pulverizer, crusher, screen, portable screening or crushing plant, or a complete stationary plant, Acme equipment will fill your requirements.



Years of continuous service testify to the ability of Acme equipment and plants. Write for our catalogue.

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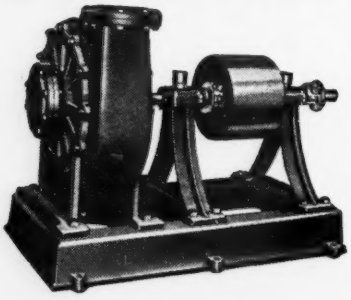
## *LIGHTNING PUMPS*



### *Will it stand the gaff?*

It will if it's a Lightning Sand and Gravel Pump. Lightning Pumps have unusual wearing qualities in addition to large capacity and economical operation.

A complete description of these rugged pumps will show you why they are the right pumps for your work. Write for Pump Bulletin.

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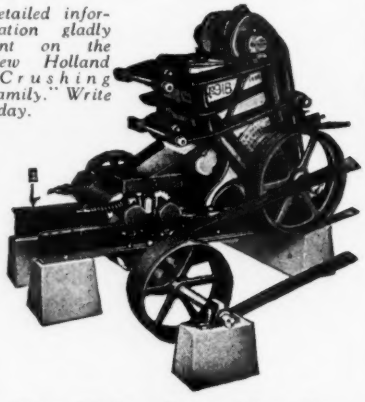
**KANSAS CITY, MISSOURI**

## *New Holland*

### Any Rock Crushed to Any Size

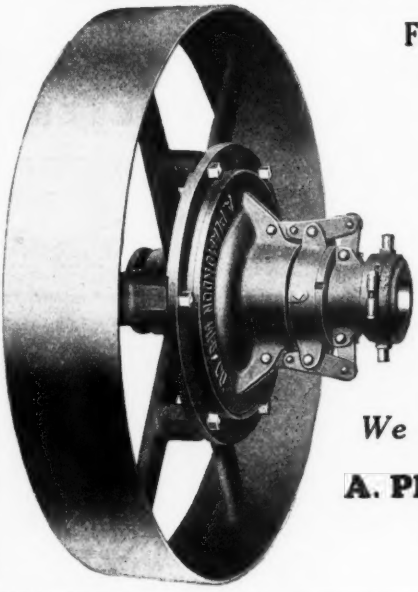
The New Holland Swing Jaw Crusher is designed to crush all kinds of quarried rock into any size down to dust. It is strongly made and designed for long, powerful strokes, giving great capacity. It is made in three sizes.

*Detailed information gladly sent on the New Holland "Crushing Family." Write today.*



**New Holland Machine Co.**
**Franklin Street, New Holland, Pa., U. S. A**

# IMPROVED PLAMONDON

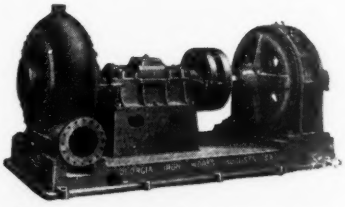


FRICTION CLUTCH PULLEYS
HEAVY WORKING PARTS
Now Made of Steel.

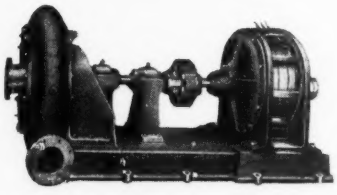
DEPENDABLE GEARS
CUT or CAST TEETH
STEEL or CAST-IRON
GENERAL MACHINE REPAIRS
PATTERN SHOP — FOUNDRY

*We Can Give You Service*

**A. PLAMONDON MFG. CO.**
5301 S. Western Blvd.
CHICAGO



**Heavy duty** directly connected motor driven sand and dredging pump. Built in 8", 10", and 12" sizes.



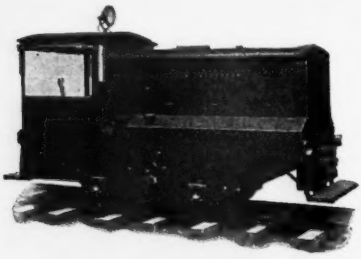
**Overhanging type** sand and dredging pump on extended base directly connected to motor.

# SAND PUMPS

The accompanying cuts show two very popular types of directly connected motor driven units. These pumps are also built for belt drive.

Send for illustrated catalog showing our complete line of this equipment including flanged fittings and hydraulic guns.

**GEORGIA IRON WORKS**
AUGUSTA, GA.



MINSTER

# *Draw Bar Pull*

Big draw bar pull is but one of the outstanding features of Minster Locomotives. Combining the best known features designed to give highest locomotive efficiency, Minster Locomotives are capable of giving complete satisfaction from both operating and financial point of view.

Minsters are tried and proved locomotives. Their records compiled from many installations, are convincing proof of their ability. Write today for complete details and catalogue.

One of the best working haulage combinations is a Minster Locomotive and Tieco Cars. Tieco Quarry Cars are built to the same high standard as Minster Locomotives. The different types of Tieco Quarry Cars are described in our catalogue.

THE INDUSTRIAL EQUIPMENT COMPANY

410-416 Ohio St., Minster, Ohio

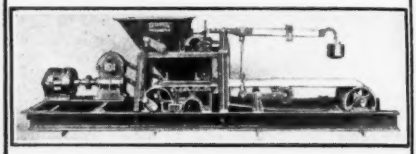
EASTERN AGENTS: K. I. CLISBY CO.
WOOLWORTH BLDG., NEW YORK

WESTERN AGENTS: J. M. WILLARD CO.
MARSH-STRONG BLDG., LOS ANGELES, CALIF.

## NO SPRINGS

No delicate contrivances, yet a machine is not obtainable that will weigh more accurately than

## THE POIDOMETER



Weight against weight is the principle upon which it operates, and it is distinctly automatic in action.

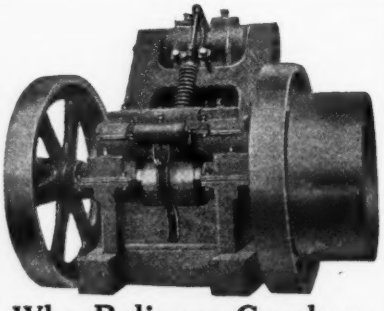
Enables materials to be handled continuously or in bulk as desired.

**Catalog sent on request.**

**SCHAFFER POIDOMETER CO.**

2828 SMALLMAN STREET

**Pittsburgh, Pa.**



## Why Reliance Crushers Should Interest You

Reliance Crushers are the result of years of experience. They are designed correctly to give maximum efficiency. They are of the best materials and rigidly inspected to give you that maximum efficiency even under adverse conditions.

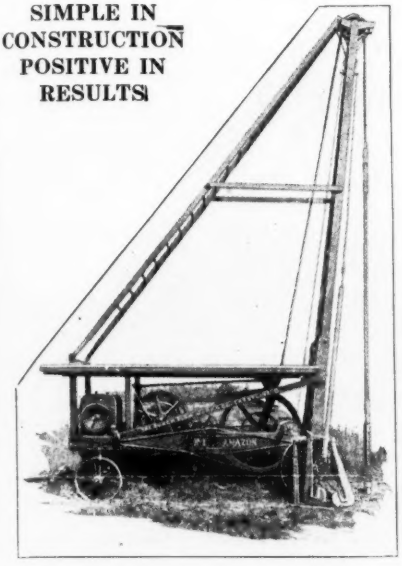
Our crusher catalogue gives some very interesting facts. Write for your copy.

*Complete Crushing, Screening and Washing Plants. Write for catalog.*

UNIVERSAL ROAD MACH. CO.
KINGSTON, N. Y.

Branch Offices
New York—298 Broadway
Boston—141 Milk Street

SIMPLE IN CONSTRUCTION
POSITIVE IN RESULTS



## The advantage of a speedy, snappy stroke

The prize fighter, engineer or individual who has made a study of blows knows that the speedy, snappy, precisely directed blow is often more effective than the ponderous sledge-hammer type of blow.

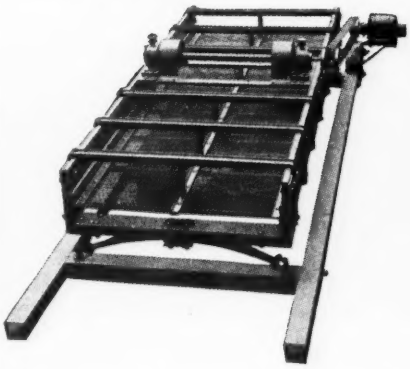
It is the powerful, speedy stroke that is a big contributing feature of the great drilling capacity of Amazon Drills. This feature, combined with easy operation, durability and economy, makes the Amazon an ideal drill for any operator requiring speedy, economical drilling. Drilling Bulletin gives complete details. Write for your copy.

THE
BURCH PLOW WORKS CO.
CRESTLINE, OHIO

# UNIVERSAL VIBRATORS

give

*UNIVERSAL SATISFACTION*



The satisfaction given by UNIVERSAL VIBRATING SCREENS lies not only in the production of a finer grade of material but from the large capacity, low operating cost, and durability as well.

There are NO FRICTIONAL SURFACES such as eccentrics, ratchets, cams or knockers to give trouble.

The UNIVERSAL is simply and rigidly constructed and operates smoothly and quietly day after day with no attention whatever.

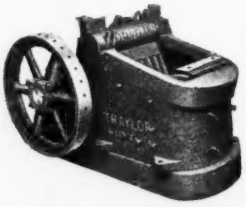
*Write today for your copy of Catalog No-50*

UNIVERSAL VIBRATING SCREEN CO.
RACINE ~ ~ WISCONSIN

*See* P&Q HAND BOOK Page 426

# TRAYLOR

## *Bulldog Jaw Crushers*



The design of the Traylor Bulldog Jaw Crusher eliminates most troubles because of the following features:

**Simple Pitman of maximum strength**
**Frictionless three-bearing toggle system**
**Self-aligning Pitman shaft bearings**
**Scientifically reinforced frame**
**Easy accessibility to all moving parts**

**ASK FOR BULLETIN**

## Traylor Engineering & Manufacturing Co.

ALLENTOWN, PA.

| | | | |
|---|---|---|---|
| New York | Chicago | Los Angeles | Seattle |
| San Francisco | Oklahoma City | Salt Lake City | Timmons, Ont. |

*EXPORT DEPT., 104 Pearl St., New York, N. Y.*

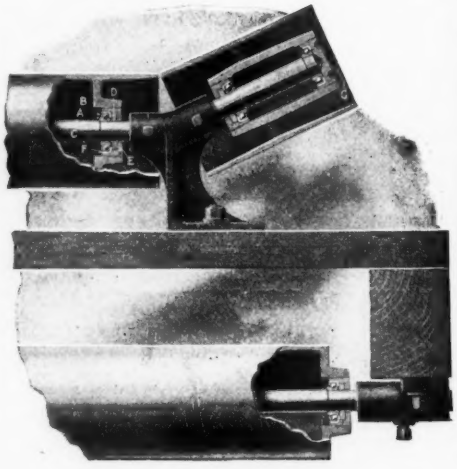
## *Consider the details of conveyor construction*

Don't buy your conveyor equipment somewhere by the foot, and let it go at that. Look into the Idler question first.

Smooth running operation and absence of friction are what you will find when you investigate Conweigh Ball Bearing Troughing and Return Idlers. Durability is another quality. Conweighs are made of hardened steel, well reinforced, and give easy access for lubrication.

The many other outstanding features of Conweigh Efficiency you will appreciate.

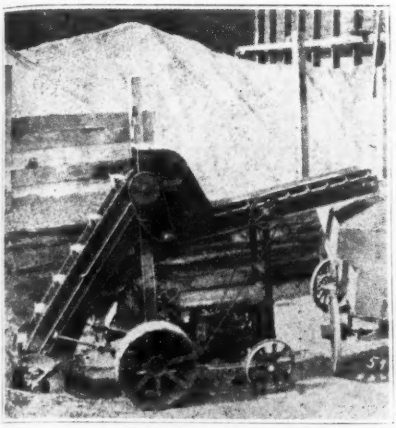
*Write for details.*



## THE CONVEYING WEIGHER COMPANY

**90 West Street** ENGINEER & CONTRACTOR **New York**

*Specialty Fordson Loaders Cut Down Loading Costs*



## They Crowd They are Self-Feeding

These are the outstanding features that force down loading costs. The Specialty Loader will crowd when buckets are in operation independent of reversing gear, and it can be crowded at will of operator for two inches or up to any distance. The crowding mechanism is self-contained with gears runing in oil.

The savings effected with a Specialty Fordson Loader will soon pay for the machine and add many a dollar to your profit.

*Write for bulletin or see any Ford Dealer.*

SPECIALTY ENGINEERING COMPANY

**Allegheney and Trenton Aves.**

**PHILADELPHIA, PA.**

## *Economical pipe service*

FOR sand, gravel or quarry service Taylor Spiral Riveted Pipe is economical. It is low in first cost, light in weight for easy transport to remote localities and easy handling; strong and rigid due to spiral rivited seam, and rust proof by virtue of heavy coat of pure asphalt or hot process galvanizing. Each length is fitted with Taylor Forged Steel Flanges. Write for descriptive catalog.

**American Spiral Pipe Works**

**Main Office & Works: Box 485, Chicago, Ill.**

**New York Office: 50 Church St.**

*Also manufacturers of Taylor Forge Welded Pipe and Fittings*

TAYLOR *Spiral Riveted* PIPE

P & Q 6-11-RTG.

**WOODHOUSE**
"TRENTON"
**DREDGE CHAIN**

*It is built right*

Woodhouse Special Dredge Chain is guaranteed strictly hand-made. Furthermore, we use an iron made for this particular need, a scientifically and chemically selected pure pig-iron, treble worked and re-rolled. It withstands shocks and strains without crystallization longer than any other known iron; hence, it breaks less while in use.

We have satisfied the most exacting operators with this chain, and have their testimonials showing that Woodhouse Chain wears at least 50 to 100 per cent longer than other makes. All Woodhouse chains are double tested. Send today for a copy of our testimonial pamphlet.

Specify Woodhouse Chain

**WOODHOUSE CHAIN WORKS**
**Third Street** **Trenton, N. J.**

---

WOODHOUSE CHAIN WORKS,
Third St., Trenton, N. J.

Send me a copy of your testimonial pamphlet.

Name .....

Firm .....

Address .....

---

**BIGGER AND BETTER**

**The New 1925 Model**

# NELSON
## FORDSON LOADER

*"The Standard of Service"*

Sixty to eighty yards an hour.
Self feeding without hand labor.
Slow crowding keeps buckets full.
Strong, well designed frames
Saves labor and truck time.
All work in plain sight of operator.
Swivel spout ten feet high.
Side or end loading of big trucks
Digs its own road into the pile.

*Write for Catalog and Prices, or Ask your Ford Dealer.*

**N. P. NELSON IRON WORKS, Inc.**
**Passaic, N. J.**

***Where we lead others follow.***

## Built for Hard Continuous Washing

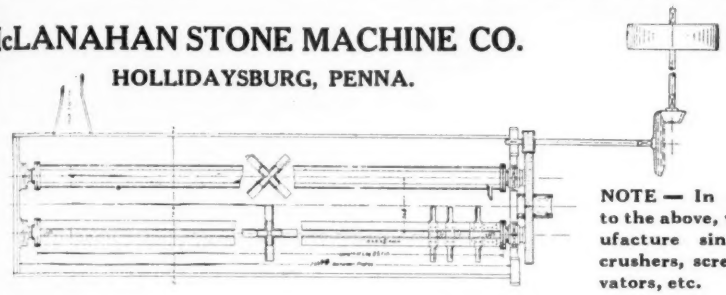
Practical experience of nearly 40 years in building gravel and ore washers has produced the most successful and complete machine ever built for washing phosphate rock, limestone and gravel.

The washers are strong boxes, the ends cast iron plates, and the entire construction is calculated, for economy of operation and convenience in making repairs.

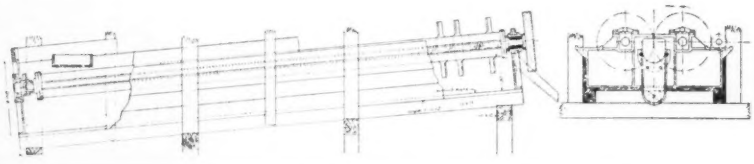
Send for our illustrated literature.

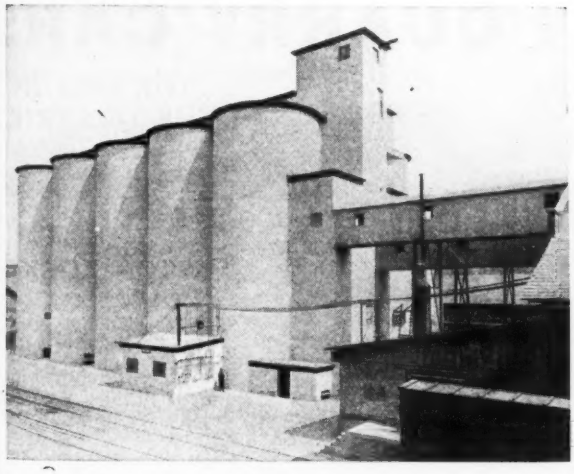
**McLANAHAN STONE MACHINE CO.**

**HOLLIDAYSBURG, PENNA.**



**NOTE — In addition to the above, we manufacture single roll crushers, screens, elevators, etc.**





*LAWRENCE PORTLAND CEMENT COMPANY*
*SIEGFRIED, PA.*

**Designers and Builders of**

**Cement Storage**
**Pack Houses**
**Slurry Tanks**
**Stone Bins**
**Power Houses**
**and**
**Machinery Installations**

***Designs and Estimates Furnished on Request***

**Burrell Engineering & Construction Co.**
**Jackson & Canal St., Chicago, Ill.**

## Model-4—Bay City One Man Excavator

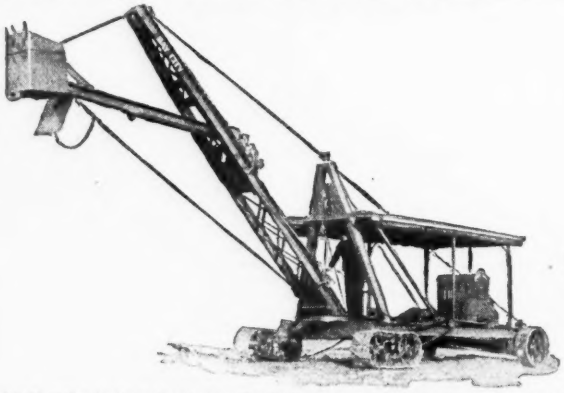
THE ORIGINAL SMALL SHOVEL

OPERATES ONE HALF YARD SHOVEL-CLAM-DRAGLINE

Shipped Assembled

Silent Chain Drive

Alemite Lubricated



Convertible

Caterpillar Mounted

Several Hundred in Operation

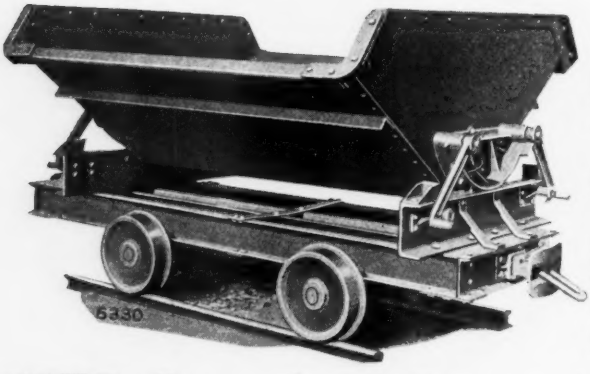
A STURDY ECONOMICAL MACHINE FOR STRIPPING OR LOADING

For larger jobs—the Bay City ¾-yd. 16B. Also Long Boom Bay Cities in 1 and 1½ yard capacities. There's a Bay City for every size plant. Several plants have purchased their 2nd and 3rd Bay City.

**BAY CITY DREDGE WORKS** **BAY CITY, MICH.**

*See* P&Q HANDBOOK Page 333

# EASTON QUARRY CARS




### THE MEN IN THE QUARRIES

— are keen about Easton Quarry Cars. They know they can't get better equipment.

### EASTON ROCKER DUMP CAR

**No. 6330-B,** — here illustrated, has an especially low body for shovel loading, — dumps on both sides. Write for Bulletin 21.

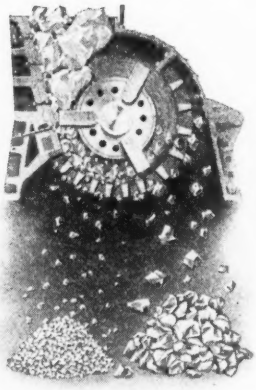
## Easton Car & Construction Co.

**Kansas City, Mo.** **Easton Pa.**

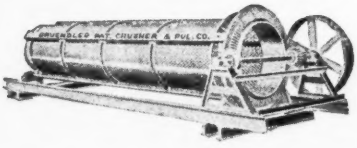
BRANCH OFFICES

New York, Philadelphia, Pittsburgh, Chicago, San Francisco.

## *Gruendler Service is Efficient, Productive and Economical—*



That is what operators say whose plants are Gruendler Equipped. Less labor, less equipment, greater tonnage, and uniform product are secured at lowest cost per ton. Gruendler crushers, revolving screens, elevators, hoists, and plant design have solved the producers' production problems.



Plants in any capacity from 3 to 6,000 tons daily. They are the result of experience and knowledge. Their exceptional ruggedness assures year 'round consistent performance with minimum upkeep.

Gruendler equipment and service will solve *your* production problems too. Consult with our engineers who will gladly analyze your crushing or pulverizing problem.

**Gruendler Patent Crusher & Pulverizer Co.**
**908 North Main St.**
**ST. LOUIS, MISSOURI**

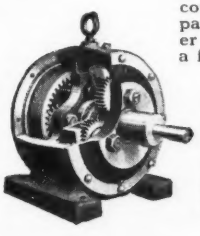
**YOU WOULD NOT GRASP A WHEEL BY THE HUB TO TURN IT!**

If you want to move a heavy weight—a long lever is the easiest way. If you want to turn a heavy wheel—you grasp it at the rim—not the hub. Why?—Because you get maximum effect from the power supplied.

**The Principle of the IXL Speed Reducer**

The Patented Feature underlying the IXL Speed Reducer is based on this fundamental principle. The power that moves the slow speed shaft is applied at the point of greatest leverage. This reduces the load on the gear teeth to the minimum.

The many uses of the IXL Speed Reducer for saving labor and space, for eliminating danger and inefficiency are fully covered in our 79 page Speed Reducer Book. There's a free copy for you—just clip the coupon, and attach to your letterhead.



Established 1895

**Send for Free Book**

**FOOTE BROS. GEAR & MACHINE CO.**

**235-245 N. Curtis St., Chicago, Ill.**

**Sales Offices in All Principal Cities U. S. A. and Canada.**

**56-N**
**Foote Bros. Gear & Machine Co.**
**235-245 N. Curtis St., Chicago, Ill.**
Please send without obligation a copy of the Foote IXL Speed Reducer Book.

Signed .....

Address .....

# CYCLONE NUMBER FOURTEEN BIG BLAST HOLE DRILLS

Whatever success Cyclone No. 14 Big Blast Hole Drills have attained in the quarry industry during the fifteen years of their existence has been due to close adherence to the following ideals and principles:

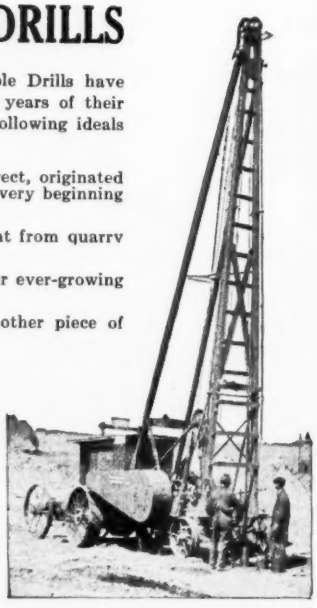
1—Starting with a design that was basically correct, originated after a close study of the requirements at the very beginning of the use of well drills in quarrying.

2—Always welcoming suggestions for improvement from quarry operators.

3—Keeping in close touch with the field and their ever-growing requirements.

4—Never holding the idea that a drill or any other piece of machinery could be perfect or faultless.

The story of the development of Cyclone No. 14 drills is completely told in our 100-page catalog B-45. It also contains 40 pages of cost and operating data on quarry drilling and blasting. Ask for a copy.



**THE SANDERSON-CYCLONE DRILL CO.**

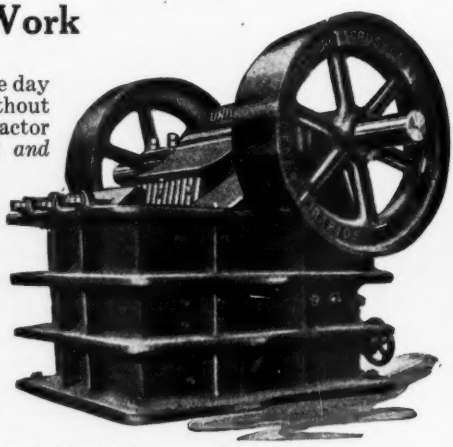
**Orrville, Ohio**

**Eastern & Export Office:**
**30 Church St., New York City**

## *UNIVERSAL CRUSHERS*

# Day after Day, The Year Around Universal Crushers Work

The crusher that will handle big tonnage day after day and do it economically without breakage and delays, is an important factor to consider. It means *bigger output and lower costs.*



*All Steel frames* combine strength and lightness. Six large opening general crushers with capacities to 450 tons per day. Six gravel and rejection crushers with capacities to 150 tons per day to pass a 1 inch ring. There is no stone too hard for these crushers.

From more than 20 sizes we can recommend a crusher just suited to YOUR job. Either stationary or portable with or without elevators and power.

*We serve the stone crushing trade everywhere.*
*Write us your requirements.*

**UNIVERSAL CRUSHER CO.** 619 C. AVE. WEST CEDAR RAPIDS, IOWA

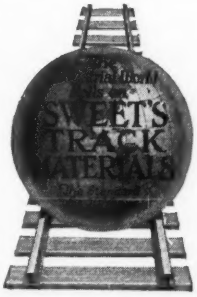
## *UNIVERSAL CRUSHERS*

# SWEET'S TRACK MATERIALS

Specify SWEET'S Portable Industrial Track if you want faster, more economical road building—if you want increased efficiency in track haulage and lowered costs.

Many of the important builders of Industrial Cars, Fabricators and dealers in Industrial Portable Track Equipment have standardized on SWEET'S TRACK MATERIALS.

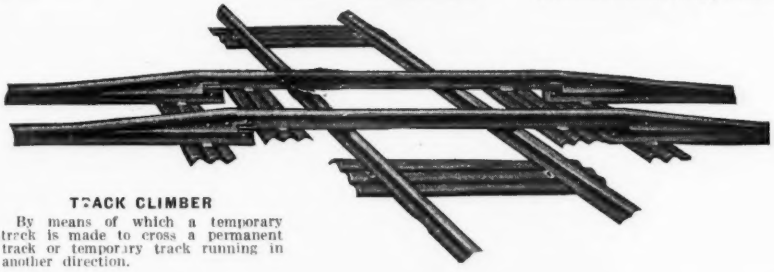
*Ask for the Sweet's Catalog—the most complete ever compiled on light track materials.*




OUR LINE OF TRACK MATERIALS IS COMPLETE Including: Standard A. S. C. E. Rail Sections (8 to 60 lb. per yard) Plain Splice and Angle Bars, Bolts, Nuts, Spikes, Sweet's Superior Steel Cross Ties with complete accessories.

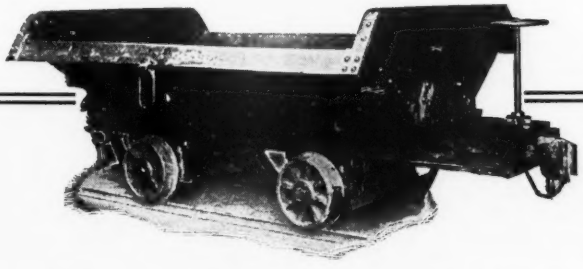
**SWEET'S STEEL COMPANY**

**WILLIAMSPORT, PA.**



**TRACK CLIMBER**

By means of which a temporary track is made to cross a permanent track or temporary track running in another direction.



# QUARRY CARS THAT ENDURE

## Under Most Abusive Loading Conditions

ATLAS CARS are designed to reduce haulage costs and last longer

*"They do both—Why not Investigate"*

Engineering Service Especially Developed in Quarry Car Design

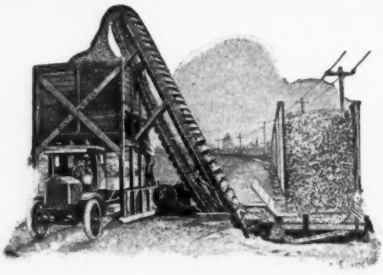
## THE ATLAS CAR & MFG. CO.

**1140 Ivanhoe Road** **CLEVELAND, OHIO**

*Quarry Cars, Rocker and Gable Bottom Cars, Special Cars of All Kinds*

# Here's What We GUARANTEE

When equipped with proper size feeder, the SUNBURY Automatic Unloader



**Will load or unload a 50-ton car in 90 minutes!**

## *The* SUNBURY Automatic Unloader

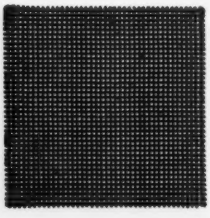
And one man can handle it. The first cost is reasonable and its return from the standpoint of its being able to substantially increase your profits makes it a very profitable investment.

Its automatic feature is important and will commend it to you. It is simple in construction, strongly built and economical in operation.

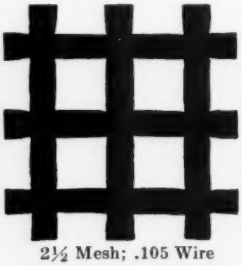
*We will be pleased to send you an illustrated descriptive circular.*

## THE SUNBURY MANUFACTURING CO.

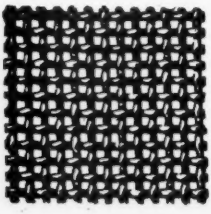
SUNBURY, OHIO



40 Mesh; .0135 Wire



2½ Mesh; .105 Wire



12 Mesh; .047 Wire

***SERVICE!*** is the one thought behind every operation in the manufacture of—

## "CLEVELAND" Double-Crimped Wire Cloth

Uniform fineness and long service will be assured by its use in screening SAND, GRAVEL, CRUSHED STONE AND CEMENT.

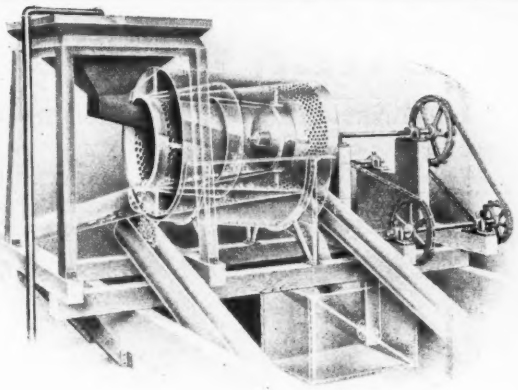
Large stock always on hand; special mesh manufactured to suit requirements at right prices.

THE CLEVELAND WIRE CLOTH & MFG. CO.

3579 EAST 78TH STREET

CLEVELAND, OHIO

# NEST -O- CONE
Patented
# SCREENS



The superiority of NEST - O - CONE Screens is found in three primary features which increase output without endangering quality. First—removal of oversize and coarse aggregate at the beginning of the screening operation gives greater feeding speed. Second—the change of direction of material flow through each screen provides better separation, prevents carry over and makes possible faster feeding. Third—the sand screen, being on outside of assembly, offers greatly increased screening area and therefore faster screening to finer materials.

Great reduction in installation cost is effected by the nesting of screen sections, which makes only one drive necessary.

Write us for detailed information.

**PIONEER TRACTORS, Inc.**
WINONA, MINN.

# Perforated Metal Screens
## FOR STONE, SAND, GRAVEL, ETC.

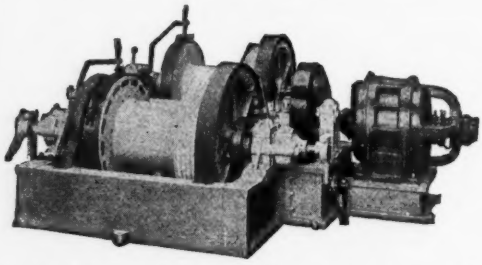
Plates flat; rolled to diameter or radius for revolving and conical screens butted or lap joints.

## Elevator Buckets
in all styles and sizes

**HENDRICK MFG. CO.,** 39 Dundaff Street CARBONDALE, PA.
30 Church St., New York City
954 Union Trust Bldg., Pittsburgh, Pa.

# LIDGERWOOD HOISTS

**STEAM—ELECTRIC—BELT DRIVE—GASOLINE**



***Types to suit all contractors' uses***

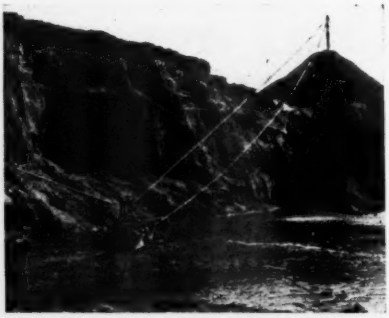
Illustration shows our Two-Speed Electric Hoist, built in sizes up to 200 H.P., *for operating slack line drag bucket excavators* up to and exceeding two-yard capacity.

A breakdown of the engine stops your entire operation; reduces your output; increases your cost per yard. *LIDGERWOOD HOISTS have strength in every part to work continuously without breakdowns.*

**HOISTS — CABLEWAYS — DERRICKS**

**LIDGERWOOD MFG. CO., 96 Liberty St., New York**

Chicago; Pittsburgh; Philadelphia; Detroit; Los Angeles; Seattle; Tacoma; Portland, Ore.; Brown-Marx Bldg., Birmingham, Ala. **Sales Agents:** Norman B. Livermore, San Francisco; Woodward, Wight & Co., New Orleans, La.; John D. Westbrook, Inc., Norfolk, Va.; Canadian Allis-Chalmers, Ltd., Toronto. **Foreign Offices:** Sao Paulo, Brazil; Rio de Janeiro, Brazil; London, Eng.



*"Pioneer Bucket Loading"*

# THE PIONEER BACK DUMP BUCKET

is one tool which is always on the job—which seldom requires repair—which is so simple as to be very nearly foolproof—and which does its work very much faster than any other slackline bucket yet devised.

If you want the bucket which reduces your troubles and increases your profits—drop us a line—ask us to show you.

## PIONEER BUCKET COMPANY

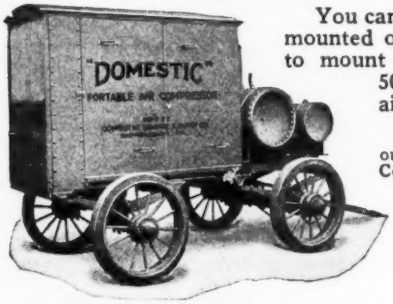
*(Successors to The Mansfield Engineering Company)*

**1011 Fletcher Trust Bldg., Indianapolis, Indiana**

DEPENDABLE "DOMESTIC" POWER UNITS

## "DOMESTIC" Compressors cut time and cost

That is what every stone quarry operator wants—better service with less expenditure of time and money. As a means to accomplish this sort of efficiency, there is nothing superior to Domestic Air Compressors. They reduce your drilling cost and time. One Domestic is equal to a dozen men with the old hand method. The difference to you is the difference between a few cents and dollars.




A 184 Cu. Ft. "Domestic" Air Compressor Mounted on Rubber Tired Trailer

You can have your "DOMESTIC" Air Compressor mounted on steel truck, rubber tired trailer or ready to mount on truck chassis, in the following sizes: 50, 62, 92 and 184 cu. ft. displacement of free air per minute.

Send for a copy of Bulletin "MCP." It describes our line of Dependable Power Pumps, Hoists and Air Compressor Units.

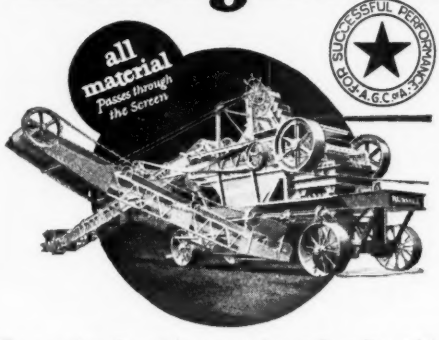
**Domestic Engine & Pump Co.**

*Manufacturers*

SHIPPENSBURG, PENNA.

PUMPS—AIR COMPRESSORS—HOISTS

# Russell Portable Screening Crushing *and* Loading Plant!




One handling of material performs all three operations—screening, crushing and loading. Conveys the material from gravel pit, screens, crushes and delivers a uniform product directly into wagon, truck or bin.

The feed back principle to crusher makes all material uniform—no oversize can pass the screen. Hopper arrangement and wide 24 inch delivery conveyor affords rapid loading of trucks. Construction of this outfit is most subtantial and durable insuring steady service and long life. Weight complete 28,500 pounds.

The complete Russell Line includes—8 Sizes Road Machines, 2 Sizes Elevating Graders, Maintenance Patrol Machines for both Motor and Horse Power; Scarifiers, Road Drags and Wheel Scrapers, Drag Lines, Gravel Screening, Crushing and Loading Equipment, Steel Beam Bridges, etc.

*A very complete 72 page catalog of special interest to all road builders—sent free and postpaid.*

RUSSELL GRADER MANUFACTURING COMPANY

Factory and General Offices—MINNEAPOLIS, MINN.

*Affiliated plants—Cicero, Ill., North Kansas City, Mo., Memphis, Tenn., Dallas, Tex.*

*Representatives in all Principal Cities.*

## Caldwell Buckets for Every Service

CALDWELL Buckets are built to give efficient performance under trying tests and widely varying conditions.

The Continuous Steel Bucket is especially adapted for handling cement, stone, crushed rock and other heavy material, and is made in various gauges of steel, to suit all requirements. They are accurately formed, and joints may be either riveted or spot welded.

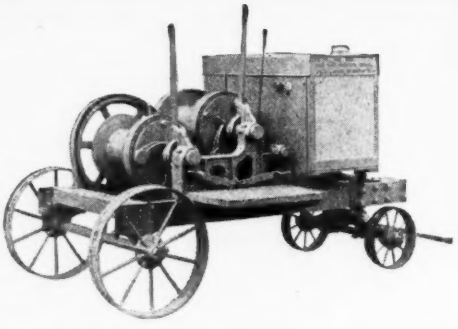
No wedging of material, or sharp corners. May be arranged to overlap, thus forming a continuous bucket elevator. Load fully, with even, complete discharge.

When considering bucket equipment, for any or all needs, remember the name, CALDWELL. Remember, also, the names of Caldwell users, gladly furnished on request.

H. W. CALDWELL & SON CO.
LINK-BELT COMPANY, OWNER
Chicago, 1700 S. Western Ave.
New York, 2676 Woolworth Bldg.
Dallas, Texas, 810 Main St.

CALDWELL

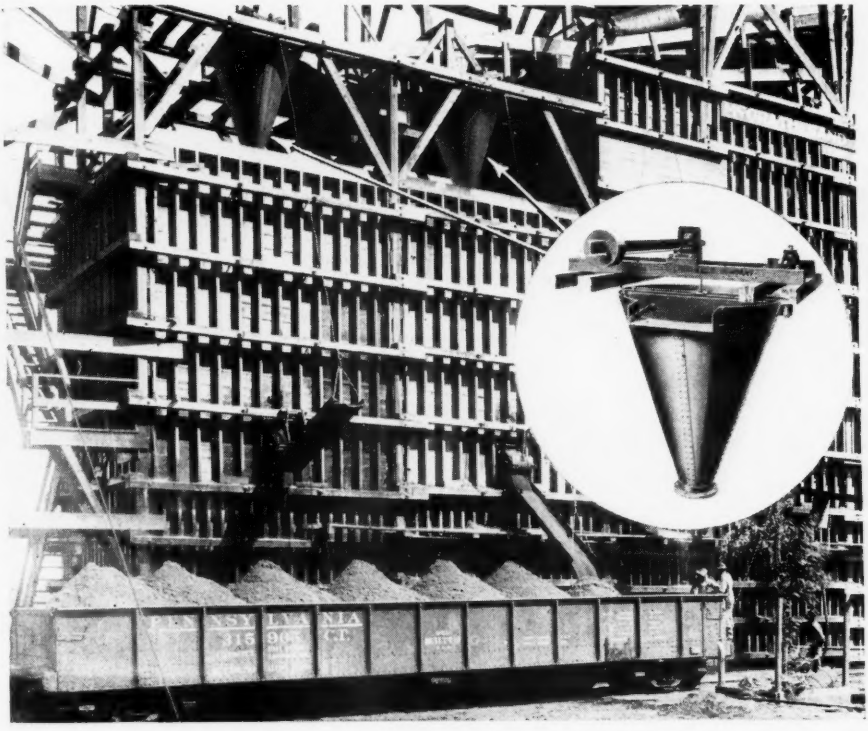
## Hoisting Strength without Excess Weight



Made of steel, portable and light, Ebel Hoists have the strength with but half the weight of cast iron hoists. Model B C weighing but 3,500 lbs. will handle a ¾ yd. Bottomless Scraper under any conditions.

We have Ebel Hoists that are ideal for Dragline, Elevators or for Pile Driving. Get in touch with us and get complete information. Also Bottomless Power Scrapers.

*LANSING MOTOR & PUMP CO.*
**Home Office, 326 S. Hosmer St., Lansing, Mich.**
**Eastern Office, 302 Broadway, New York City**



# Link-Belt Conical Sand Separator

THE sand separator is one of the most important parts of a washing plant. A poor one will spoil material as fast as it is prepared.

The Link-Belt Conical Sand Separator is an automatic device for separating sand from water and silt, and delivering it through a counterbalanced valve to the bin.

With the Link-Belt Separator, and its definite removal of the impurities with the water as it flows away, the sand is really clean and the full value of the washing process maintained, a distinct improvement over types that allow the percolation of the muddy water through the sand.

Our Book No. 540 shows its construction and operation. Ask for it.

LINK-BELT COMPANY

Leading manufacturers of Elevating, Conveying and Power Transmission Machinery

PHILADELPHIA, 2045 Hunting Park Ave. CHICAGO, 300 W. Pershing Road
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LINK-BELT

THIS YEAR 50 LINK-BELT IS FIFTY YEARS OLD

Dependable Power for Every Purpose

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FOR twenty-four years—nearly a quarter of a century—Continental Motors Corporation has been considered headquarters for gasoline power. To this headquarters come manufacturers from every field to lay their power problems before this master motor-building organization. Here the experience, skill and ability of the world's largest builders of gasoline power units are at their disposal. As a result of this cooperation Red Seal Continental Motors are giving unfailing and economical performance in every industrial field.

*Put Your Power Problems Up To "Power Headquarters"*

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